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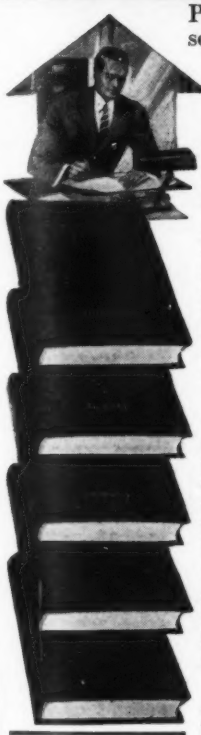

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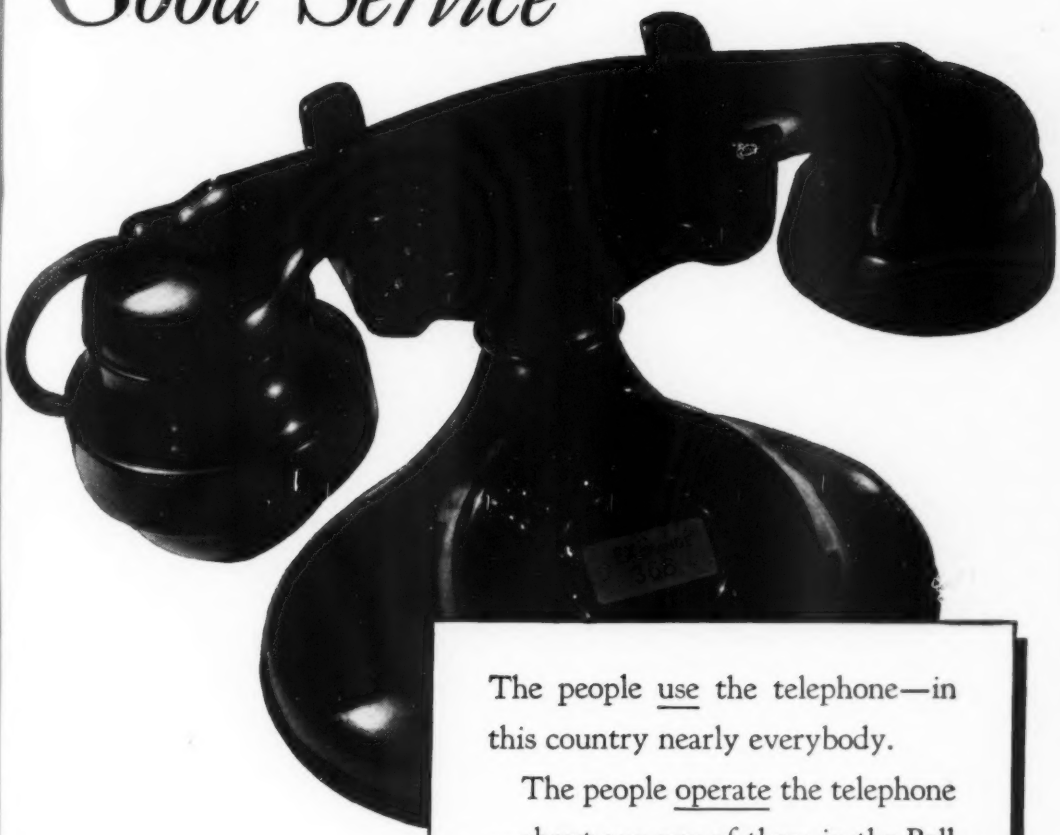

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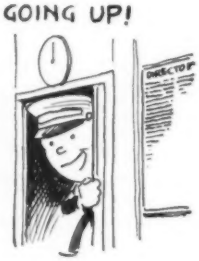
Our Readers Say

Henry Saw the Light, but Failed To Smell a Rat

HAVING read in "Our Readers Say" of several ways of disposing of rats—which didn't help me out a bit—I want to stick in my two-bits' worth. I had a rat until yesterday. In fact, I have been host to this beastie for the better part of a year, and have tried everything under the sun but poison to get rid of it. We called our rat Henry. He was prankish and very canny. He had practically become one of the family. Now Henry has passed on, and I come to the point of this rat tale. It was Sherlock Holmes, I believe, who said "It's like using a trip hammer to crack a walnut. Nevertheless, the nut is effectively cracked." My "trip hammer" was composed of the following: A photo-electric cell, spot light, house-current solenoid, clamp, twelve-inch "two-by-four," and .22 caliber rifle. Henry always arrived in the kitchen via a floor register in the pantry. I arranged the foregoing materials on the floor so that when the light beam was intercepted, the solenoid discharged the gun, sending the bullet along the light beam into the "two-by-four." At 4:30 A.M., Henry obligingly committed suicide.—R.J.B., Columbus, Ohio.

Take This Elevator If You're Interested in Higher Physics

ANYBODY who's ever twirled a watch chain around his finger knows that as the radius of the arc decreases, the revolutions of the watch chain speed up. Now, let's take an elevator—take it up to the eighteenth floor of one of our tall office buildings. The counterweight goes down as we rise. But the building is on the perimeter of the revolving earth. Therefore the descending counterweight is revolving—at some 700 miles an hour—with it. As the radius of its arc decreases, doesn't it tend to exert a sideward pressure against its tracks? Also don't the cables it's suspended on do likewise, bellying out somewhat? And don't they belly the other way as they travel upward?—P.O.C., East Orange, N.J.



But Grandpop! What Wonderful Wars You Had!

I'VE got a lot of good ideas out of P.S.M., and now it has solved a big problem for me: What I'm going to do for my country in the next war to make the world safe for democracy or whatever it is. In my old age, when my grandchildren gather around my knees and ask "Grandpop, what did you do in the Second World War?" I'll say, "I served with a mobile airport." That outfit you described in your December issue looks to me like a machinist's dream come true. Chasing across the country with that beautiful assortment of tools and machines would combine the best features of a camping trip and a de luxe home workshop. It would be worth the trouble of dodging a few bombs. You can have your submarines and airplanes to ride in during the next war. Just give me the chance to serve my country in one of those dream workshops. Let the pacifists keep quiet and mind their own business.—A.M., Birmingham, Ala.

P.S.M.'s Full-Color Pages and New Size Earn a Bouquet

HAVE been a subscriber to P.S.M. for eight years, and I have always been delighted with it—enjoying every page of it. Now it comes in more the form of a book, with smaller but many more pages, and I think this is an improvement. The beautiful full-color pages make it all the more attractive. I wish to thank and congratulate the editor and his staff for this novel improvement in our P.S.M. And I will express the hope that, in this new form, P.S.M. may continue as successfully as it did in the old form, for many years to come.—W.J., The Hague, Holland.

A Candid-Camera Fan Gives the Doctor a Tip

REFERRING to the contraption of Dr. James Stotter, the surgeon who photographs his own operations, described on page 79 of the November issue: Ingenious? Yes. Clumsy? Sure. Complicated? Undoubtedly. Efficient? I don't think. A modern miniature camera with a spring-controlled *(Continued on page 14)*

"IT TOOK ME TWO DEPRESSIONS TO 'CATCH ON'!"

"Sure, I was 'sitting pretty' in 1928. Good job, swell girl, no worries. Then—*bang!* — it's '29 and I'm one of the first to be fired! Those were a couple of tough years, I'm telling you. Couldn't find work, and I'd been planning to get married!

"When things picked up, I was back at work — coasting along at the same pay on the same job. I got married. Thought some about the future — but didn't *do* anything about it.

"Then 'recession' came, and I was out again! But I noticed something this time. I noticed that the *trained* men, the boys who knew more than A-B-C about their jobs, weren't 'let out' right off the bat! In fact, the four fellows I knew who had been taking I. C. S. Courses kept their jobs right through the slump!

"Then I 'caught on'! I'm back at work again — and, believe you me, I'm going to stay here! The day I was rehired, *I enrolled with the I. C. S.!* They tell me there are 100,000 men enrolled with those Schools right now. (Fact is, I learned recently that my boss is an old I. C. S. graduate.) And if another business slump comes along, I'll be prepared to weather it! Because I know that the *trained* man is the *only* man equipped to 'ride out' stormy business seas!"

• • •

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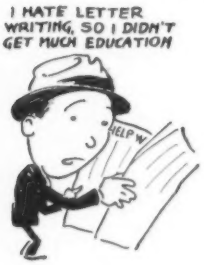
Our Readers Say (CONTINUED)

shutter and film wind and an electrical release would give the good doctor the following advantages: A neater-appearing operating room. Quicker action. A single foot switch. More exposures.—H.G., Milwaukee, Wis.

Correspondence-School Course Gave Him the Mailing Habit

IN THE November issue, you published a "tricky-channel" problem. What's tricky about it? I am a correspondence-school mathematician so I walked right through it and, from habit, I mail the solution. If A is on the west bank, set your compass course at 56 degrees, 28 minutes, north, and you'll row smack into B. As to the roller bearing, I've never seen one, but I'll bet the groove cross section and the roller contour are not the same. In other words, each roller contacts the inner ring at only one point and the outer ring ditto, otherwise they *would* slip.—P.W., Buffalo, N.Y.



All His Eggs in One Basket Wasn't the Idea Here

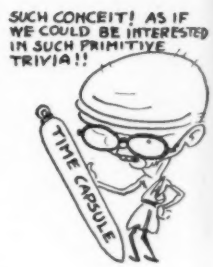
THIS should be the answer to the money-and-envelopes problem given in your May 1938 issue. The number of envelopes received by each family was 1,443, divided within each family as follows: Mrs. Jones, 607 envelopes, $368,449; Jones, 493 envelopes, $243,049; Jones child, 343 envelopes, $117,649. Mrs. Smith, 663 envelopes, $439,569; Smith, 507 envelopes, $257,059; Smith child, 273 envelopes, $74,529. Mrs. White, 777 envelopes, $603,729; White, 555 envelopes, $308,025; White child, 111 envelopes, $12,321.—D.E.C., Chicago, Ill.

An Electrician Wants Plans for Efficient Parking Lights

ARTICLES on how to install useful things on your car appeal to me very much. I'd like to put in a request for you to assign one of your writers to prepare a good one describing how to hook up auxiliary parking lights, operating on a single switch, that would economize on battery current. I am an electrician by trade and education, and "mechanic born." I enjoy your magazine more than any other of the several I have been taking.—H.M.D., West Somerville, Mass.

This "Rip Van Winkle" Knows When He'd Want To Wake Up

HERE'S to A.E., of Philadelphia, Pa., who asks how long you'd want to sleep if you could go to sleep like old Rip Van Winkle. He wants to know what future date seems most interesting to wake up on. The answer is on page 110 of the same issue of your fine magazine: "The year is 8113," when "Spired cities built by the ancient people of the twentieth century have long since crumbled to dust." For in that year, the "crypt of civilization," described in the article, will be dug up and opened. Of course, some of the information contained in the Oglethorpe University vault would be old stuff, because in the year 6939 the "time capsule" buried under the site of an ancient World's Fair would have been opened. But that would have been just a sample of the material to be found in the unopened vault. I repeat the first sentence of that fascinating article: "The year is 8113."—I.A.C., South Bend, Ind.



It's Open Season Any Time for Spanking Politicians

JUDGING from their letters, your readers seem to be the type that make our best citizens in this troublous world. Look around you. In all the states, it seems, people believe that getting money from Uncle Sam is the height of getting a living. Those people are not bothered with who supplies the money so long as they get it, and it looks like the politicians think it is all right to hand it out, too, just so long as it is not their own money. The big trouble is that the earnest workers, such as many that write to you, are so busy working that they have no time to check on their fellow citizens. But there will come a time when they will be compelled to stop their work and give the tax eaters what will amount to a spanking—just in what form it is hard to say. Let me add, it's a pleasure to read what the other fellows have to say. So long as we have such outlets for free speech *(Continued on page 16)*

THOUSANDS NOW PLAY

who never thought they could!

Learned Quickly at Home

I didn't dream I could actually learn to play without a teacher. Now when I play for people they hardly believe that I learned to play so well in so short a time.
*H. C. S., Calif.

Plays on Radio

I am happy to tell you that for four weeks I have been on the air over our local radio station. So thanks to your institution for such a wonderful course.
*W. H. S., Alabama

Wouldn't Take $1,000 for Course

The lessons are so simple that anyone can understand them. I have learned to play by note in a little more than a month. I wouldn't take a thousand dollars for my course.
*S. E. A., Kansas City, Mo.

Surprised Friends

I want to say that my friends are greatly surprised at the different pieces I can already play. I am very happy to have chosen your method of learning.
*B. F., Bronx, N. Y.

Best Method by Far

Enclosed is my last examination sheet for my course in Tenor Banjo. This completes my course. I have taken lessons before under teachers, but my instructions with you were by far the best.
*A. O., Minn.

*Actual pupils' names on request. Pictures by professional models.

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Our Readers Say (CONTINUED)

as magazines like yours afford us, there's little chance that any dictatorship will overtake us.—G.F.B., Fort Worth, Tex.

Pick Up Your Trains and Go Home When He Starts Experimenting

MAY I submit a theoretical question, the answer to which I'm in doubt about. Assuming that two forces, let us say automobiles, are rushing toward each other on a level road. If one is going 100 miles an hour, and the other eighty miles an hour, which car would be damaged the more when colliding head-on? My theory is that if they were of similar make and model, they would be equally wrecked. One way to experiment, which I am not equipped for, would be to run two model trains into each other, going at different speeds. On the front of each have some kind of scale to record the force of the blow each receives.—J.R., Rankin, Pa.

He's Not Quite Tuned to the Proper Wave Length

SINCE becoming a regular reader of your magazine more than a year ago, I have eagerly anticipated the arrival of the new issue each month. But I always have to skip over the radio section and, much to my disappointment, leave those excellent-looking plans untried. I do this for one reason only: I don't know the first thing about radio. Therefore, I suggest for the benefit of others in the same fix that you include material to help the beginner learn the fundamentals of radio in your future issues, supplemented by lists of references for more advanced reading. This may also apply to the photography department.—D. da C., Oxford, Ohio.

So a Steam Roller Standing Still Is Perfectly Streamline

IT STRIKES me that A.R.I. is a little off on just what is meant by "streamline." He says it is an "absolute" word, like "unique," so that there can be only one perfectly streamline design for an airplane, boat, automobile, or what have you. He forgets that an object may be perfectly streamline for traveling through a given medium at a certain *speed*, but not for all speeds. For when the speed is stepped up, or down, the object must be redesigned to present a new ideal shape for minimum surface resistance. The best engineers can do is design a car, for example, that presents minimum air resistance at its average operating speed. When they have done this, I say that they are justified in calling their car "streamline." Justified by common usage of the word and by practical common sense.—O.T.J., Milwaukee, Wis.

He Has No Kicks Except for the Kickers

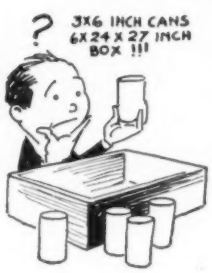
THE writer has been a subscriber for the past several years, and has no kicks. The truth of the matter is, if it were up to the persons who are crabbing about the magazine to publish it, I am afraid that the subscription list would be speedily reduced.—T.C.E., Manitowoc, Wis.

This Is No Subject To Bring Up in the Middle of Winter

MAY I correct an error of statement on page 67 **of your November issue. Your** correspondent says that the water in the storage lakes will always be above freezing, even in subzero weather, "due to the enormous pressure of the ice and water above." This is not true. The freezing point of water is very insensitive to pressure. The truth of the matter is that when any body of water is cooled sufficiently, convection currents are set up, causing the entire mass of water to become the same temperature, namely, four degrees centigrade, which is the temperature of maximum density. After this, ice forms on the surface and acts as an insulating blanket to the water below. If the cold spell lasts long enough, the ice becomes thicker and thicker, and at the same time a better insulator. The water at the bottom of the lake remains at the constant temperature of four degrees, provided the ice layer does not reach the bottom, which it will not do if the lake is deep enough.—D.O., Berkeley, Calif.

How Many Fruit Cans Will Fill Up This Box?

ISN'T it time for another problem for the solid geometers? A box whose inside dimensions are 6" by 24" by 27" is to be filled with fruit cans whose diameter is 3" and height 6". The problem is to pack the maximum number of cans into the box. Contrary to the obvious solution, the correct answer is not 72. Although I am fond of solid geometry, I cannot solve the problem. Yet the answer doesn't seem very far beyond my grasp. Can some of my fellow puzzle fans help me out.—B.S., Chicago, Ill.



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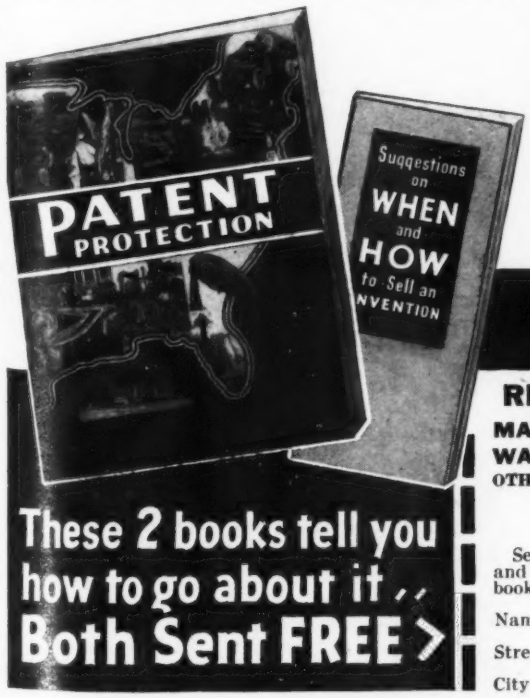

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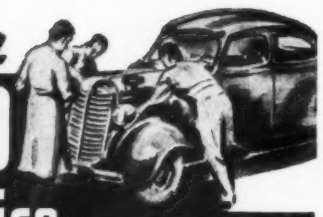

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1801 E. 65th St., Cleveland, O. Dear Mac—Immediately after leaving school I went to work for United Motors and am now located in Cleveland where I hold a good position. I have been able to take care of the most complicated electrical jobs. I think I have done fine considering I had no experience before coming to your school. —Hubert Todd

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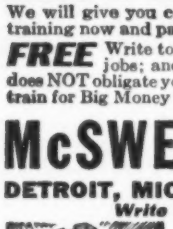

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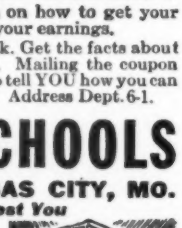

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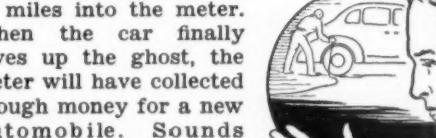
With the Inventors

• • •

HOW would you like to have cash ready and waiting to buy a brand-new car when your present jallopy finally begins to creak and groan with age? George Miller, of Chester, Pa., recently invented a "depreciation meter" to make this dream come

true. The device, attached to your present car, would make it impossible for you to run it until you dropped the price to cover depreciation, wear, and tear for a given number of miles into the meter. When the car finally gives up the ghost, the meter will have collected enough money for a new automobile. Sounds something like the old-fashioned gas meter that had to be fed a quarter before it would let through enough fuel to cook supper. . . EASE IN WASHING a car is the idea of an implement designed by Burgess Cockcroft, of Chicago, Ill. The nozzle at the end of a length of flexible hose is held in the palm of a person's hand by metal rings that clamp around the fingers. When the hose is attached to a garage faucet, clean water flows continu-



ously into the sponge or cloth with which the car is being washed. . . ANOTHER CLEANING AID goes to the credit of David Paul, a Brooklyn, N. Y., inventor. This is a metal holding device by which a scrub brush can be attached near the base of a mop handle. Floors can thus be scrubbed and mopped at the same time. . . BRAKES AND ACCELERATOR of an automobile are controlled by a single pedal in a device worked out by John W. Ruhstorfer, of Detroit, Mich. Mounted on a

(Continued on page 24)

To the man who wants to enjoy an ACCOUNTANT'S CAREER

IF you're that man, here's something that will interest you.

Not a magic formula—not a get-rich-quick scheme—but something more substantial, more practical.

Of course, you need something more than just the desire to be an accountant. You've got to pay the price—be willing to study earnestly, thoroughly.

Still, wouldn't it be worth your while to sacrifice some of your leisure in favor of interesting home study—over a comparatively brief period in your life? Always provided that the rewards were good—a salary of $2,000 to $10,000?

An accountant's duties are interesting, varied and of real worth to his employers. He has *standing!*

Do you feel that such things aren't for you? Well, don't be too sure. Very possibly they *can* be!

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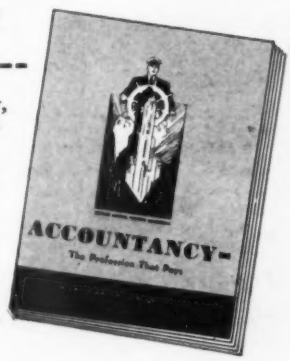

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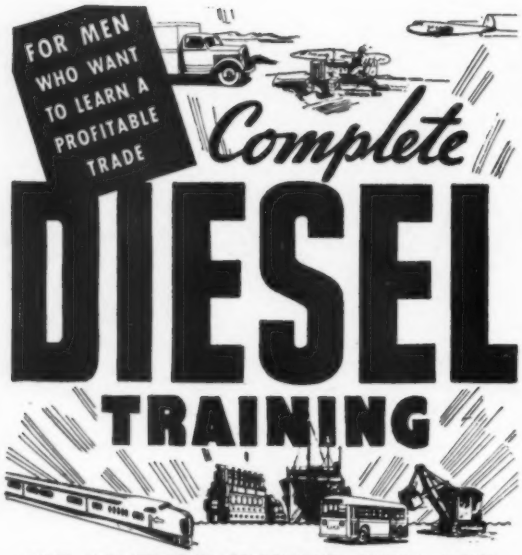

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(Continued from page 22)

central fulcrum, the pedal has an accelerator-actuating arm extending down from the toe of the pedal, and a brake-actuating arm from the heel. The operator presses the pedal with the front part of his foot to control the accelerator and with the back to control the brake. A spring under the back end of the pedal keeps the brake-accelerator at a neutral position when no pressure is being applied on it. . .

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(Continued on page 26)

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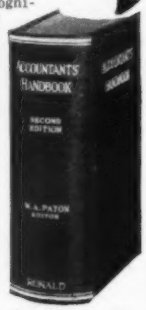

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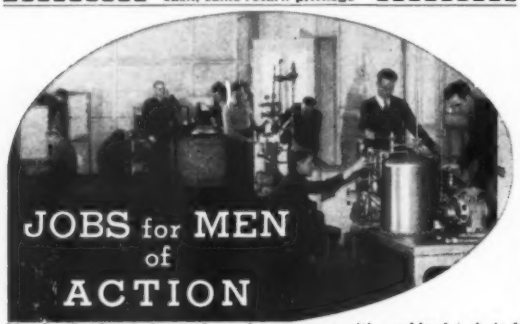

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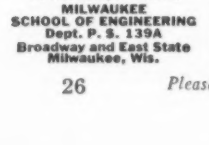

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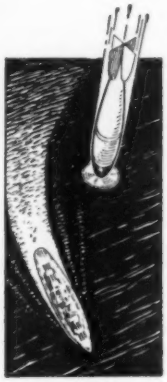
(Continued from page 24)

matically going into operation the instant the bomb is released from a plane, the whirling propeller gradually turns a screw that brings the firing pin into position for detonating the bomb charge on contact with any object. Present fuse mechanisms for this purpose, Brayton states, are practical but very complicated and expensive to produce. . . A SHAVING BRUSH that produces its own hot water for working up a rich lather, is the invention of William G. Frazier, of Philadelphia, Pa. The base of the brush handle houses a tiny, chemically fueled furnace to heat water in a small reservoir immediately above. The hot water then seeps through the brush bristles. A thermostatic unit shuts off the heater when the water reaches a specific temperature. . . THE DEMAND for copies of patents on file in Washington, D. C. runs to about 7,000,000 a year. . . . ANOTHER BATHROOM ACCESSORY is a combined grab rail and seat for bathtubs, devised by George B. Bentz, of New York City. The seat and rail are attached to U-shape clamps that straddle the side wall of the tub. The unit is collapsible for compact storage when not in use. . . PROPER FITTING of gas masks to civilians during the recent war scare in Europe caused much worry and official gnashing of teeth. Two workers at the Edgewood Arsenal, Edgewood, Md., believe they have a solution to this problem in a universal gas-mask face piece said to fit faces of all sizes and shapes. It differs from present types in the special shape of the blank from which it is molded. The mask is covered by a special patent that makes it available to the U. S. Government without payment of royalty. . . ONE HUNDRED AND ELEVEN patents granted to one inventor at the same time—



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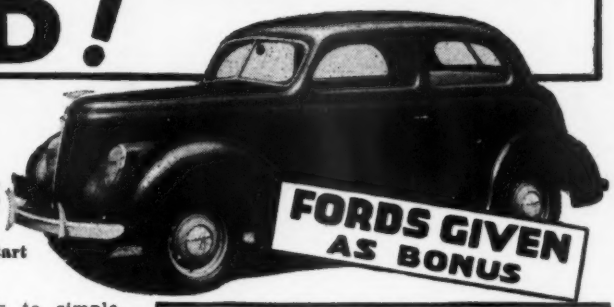

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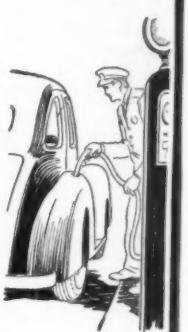
(Continued from page 26)

that's the record recently set up by Gustave Erhard, of Scranton, Pa. All were design patents relating to ornamental curtain patterns. Filing fees alone cost the inventor $1,100. . . THE HENS probably won't like it much, but they will have to put up with an ingenious egg meter recently devised. The meter, strapped to the hen, registers the number of eggs an individual hen lays so that the owner of a large number of hens can keep track of the egg-laying efficiency of the occupants of his hen house. As each egg is laid, it touches a lever that registers the event on a meter on the hen's back. . . FRANCES W. DUNMORE, veteran radio engineer at the U. S. Bureau of Standards in Washington, D. C., contributed the basic ideas for a new automatic radio control designed to land an airplane with no help whatsoever from the pilot. The latter merely sets the controls as the plane nears an airport, and then sits back to let the automaton handle all details of the landing. The device, it is said, will regulate plane speed, make adjustments for cross winds, operate wing flaps and tail controls, and even apply wheel brakes to halt the plane at a definite spot on the landing field. . . GAS TANKS are incorporated into the rear fenders of an automobile in a design worked out by Brooks Walker, of Piedmont, Calif. This should leave more space for luggage and spare tire at the back of a car, but what happens if a road hog nips the rear fender? . . . PERHAPS this inventor and one who has just taken out a patent on a shockproof car should get together. The shockproof car is encircled by a thick, heavy, resilient rubber bumper which even covers the wheels. If a collision occurred with this type of car, there would be no crash, just a bounce, and a fender-mounted gasoline tank would be less susceptible to serious damage.



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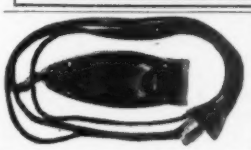

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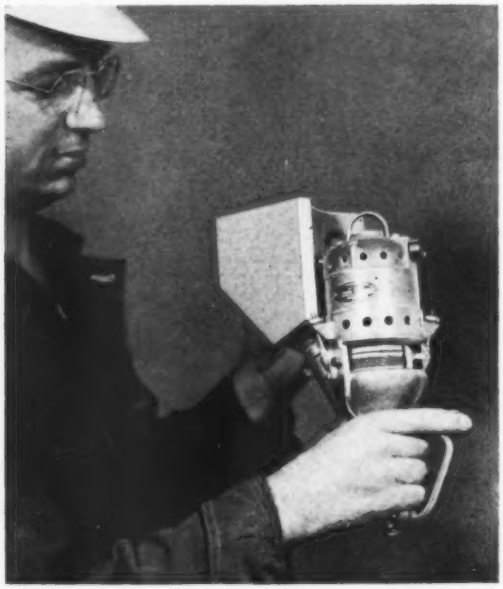

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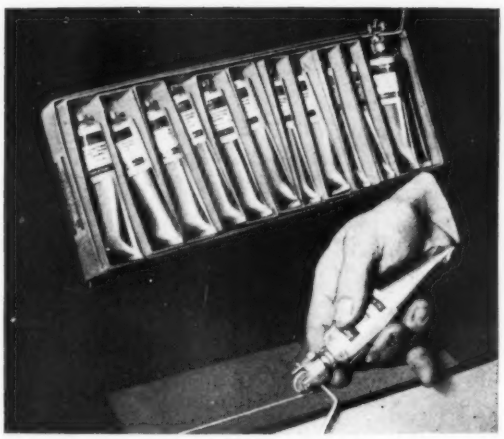
Sawhorses Easily Made With New Metal Clamps

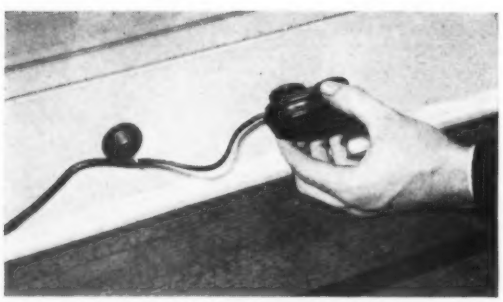
SAWHORSES are constructed quickly and easily with metal joints now available. Two-by-fours of a desired length slip into pockets in the joints as legs, while the ridge is clamped in toothed jaws.

Ingenious Striping Tool



FINE lines can be painted easily with an ingenious striping tool that fits over the ends of collapsible tubes of enamel. The tool has an adjustable guide arm and a set screw to control the paint flow.

Auxiliary Outlet Sticks to Any Surface



TWO suction cups hold a new double electric outlet in place on a baseboard or wall. Another cup serves to take up the cord's slack and keep it clear of the outlet. The device can be applied without the use of tools, screws, nails, or clips, and is especially useful where it is not possible to install a standard outlet that lies flush with a wall surface. It can be attached to glass, tile, and metal, as well as to painted wood surfaces that are reasonably flat and are nonporous as well.

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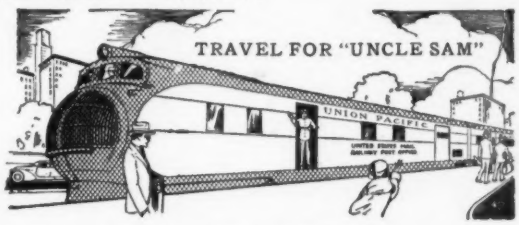

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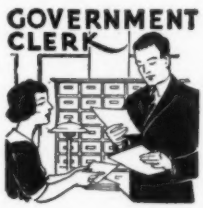

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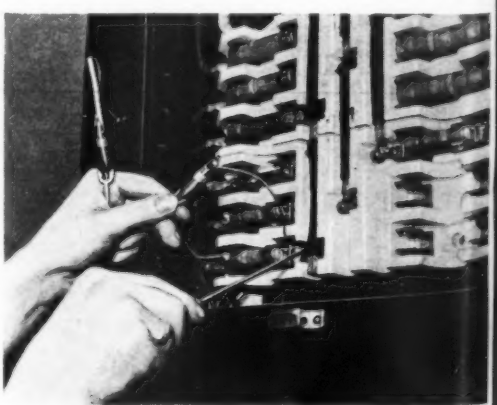

Installing an indicator unit across the terminals of a fuse. A neon bulb lights when the fuse blows

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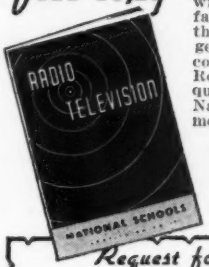

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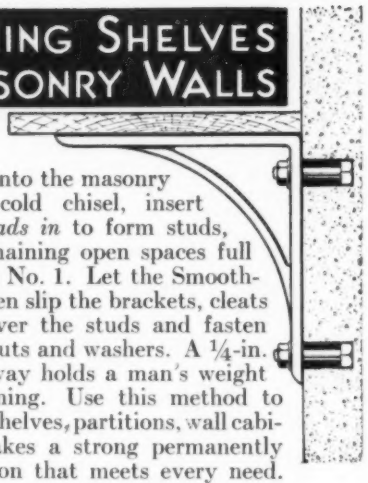

CUT holes into the masonry with a cold chisel, insert bolts *with heads in* to form studs, and tamp remaining open spaces full of Smooth-On No. 1. Let the Smooth-On harden, then slip the brackets, cleats or uprights over the studs and fasten with nuts or nuts and washers. A ¼-in. bolt set this way holds a man's weight without loosening. Use this method to anchor cellar shelves, partitions, wall cabinets, etc. Makes a strong permanently tight connection that meets every need.

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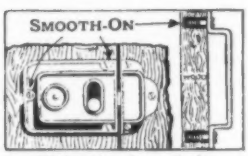

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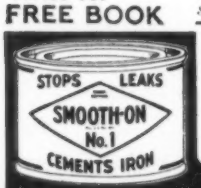

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Questions FROM HOME OWNERS

Q.—WHENEVER steam starts to come up our heating system, we notice a definite thumping sound which seems to be in the walls. Can you tell us what causes this annoying noise, and how it can be fixed?—H.L.Y., Duluth, Minn.

A.—THE thumping sound may be caused by steam forcing its way up through the pipes against plugs of water from condensation flowing downward toward the furnace. Readjusting the slope of the pipes should end the trouble. However, the noise could also be caused by movement of the pipes as they pass between upper and lower floors through holes that are too small to allow them to expand and contract freely. If you find this to be the case, you should enlarge the holes enough to eliminate friction.

Varnish in Paint Brushes

F.G., STEUBENVILLE, OHIO. If amyl acetate, available in most drug stores, is poured over a hardened paint brush, the varnish in it will dissolve almost immediately. The acetate can then be easily removed from the brush with the use of alcohol or oil of turpentine.

Nonskid Cement Walk

Q.—IS THERE anything that will roughen a smooth-finish cement sidewalk to make it less slippery in wet weather?—A.W., Racine, Wis.

A.—FIRST wet the surface, then apply a ten-percent solution of muriatic acid and let it stand until the acid etches into the concrete surface and thereby roughens it. Then rinse the sidewalk thoroughly with water. Another method is to chip the surface lightly with an air hammer. This should be done by an expert.

Translucent Window Covering

Q.—FOR the sake of privacy, I want to paint the glass in one of our windows that faces directly onto the street. What procedure should I follow to produce this effect?—M.H., Lansford, Pa.

A.—A MUCH easier and more satisfactory method than painting would be to obtain at a hardware store a sheet of thin, translucent paper that can be stuck onto the glass. These come in various designs. They will admit some light, but no one will be able to look in your window.

ADVERTISING PAGES REMOVED

VOL. 134, NO. 1

POPULAR SCIENCE
Monthly
RAYMOND J. BROWN, Editor

JANUARY, 1939

Radio feelers gauge the distance from a plane to the nearest point below, and register it on the dial

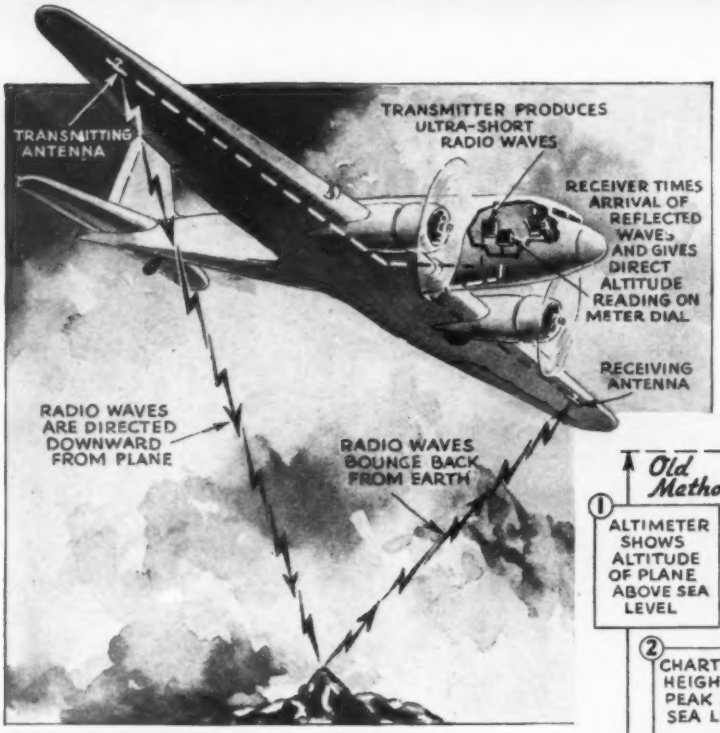
Radio Altimeter

PROMISES NEW SAFETY IN AIR TRAVEL

ABOARD a big United Air Lines plane, droning over New York City a few weeks ago, aeronautical engineers and news reporters witnessed the successful try-out of an instrument brand-new to aviation. Called a terrain-clearance indicator, or radio altimeter for short, it is declared the first practical device for registering directly the exact height of an airplane above the ground. Airmen hail it as one of the greatest contributions ever made to air safety.

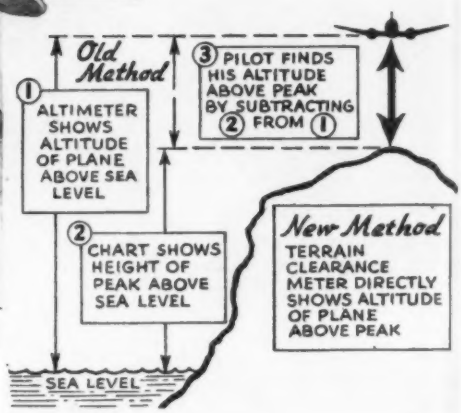
If a pilot flies along an airway enveloped

By ALDEN P. ARMAGNAC


TRANSMITTING ANTENNA
TRANSMITTER PRODUCES ULTRA-SHORT RADIO WAVES
RECEIVER TIMES ARRIVAL OF REFLECTED WAVES AND GIVES DIRECT ALTITUDE READING ON METER DIAL
RECEIVING ANTENNA
RADIO WAVES ARE DIRECTED DOWNWARD FROM PLANE
RADIO WAVES BOUNCE BACK FROM EARTH

"ABSOLUTE" ALTITUDE

The drawing at the left explains how radio waves of ultra-high frequency bounce back to the plane from the ground below to measure the distance. Below, the simplicity of the new method is contrasted with the use of the conventional altimeter of the barometric type


Old Method
1 ALTIMETER SHOWS ALTITUDE OF PLANE ABOVE SEA LEVEL
2 CHART SHOWS HEIGHT OF PEAK ABOVE SEA LEVEL
3 PILOT FINDS HIS ALTITUDE ABOVE PEAK BY SUBTRACTING 2 FROM 1
New Method
TERRAIN CLEARANCE METER DIRECTLY SHOWS ALTITUDE OF PLANE ABOVE PEAK
SEA LEVEL

in fog, the radio probe enables him to take constant "soundings" of the distance to earth, such as a ship takes of a channel. In case the fogbound plane is off its course, and the pilot is unwittingly approaching a mountain peak at dangerously low altitude, the new instrument warns him in ample time to gain elevation and avert a crash. When he descends at an airport in a blind landing, the radio feeler "senses" the approach to earth and signals exactly when the wheels will touch the ground.

Essentially, the new instrument consists of a transmitter that directs radio waves to earth, a receiver that catches them as they bounce back to the plane, and a timing device sensitive enough to clock the infinitesimal fraction of a second required for the round trip. A dial pointer translates the time interval directly into hundreds or thousands of feet from the ground.

This actual or "absolute" altitude can be arrived at only indirectly with an altimeter of the standard barometric type, which responds to diminishing air pressure with increasing height, and simply shows how high the plane is flying above some arbitrary level, such as sea level. To find his real height above any particular

One of the two antennas of the radio probe, set under the wings of the plane

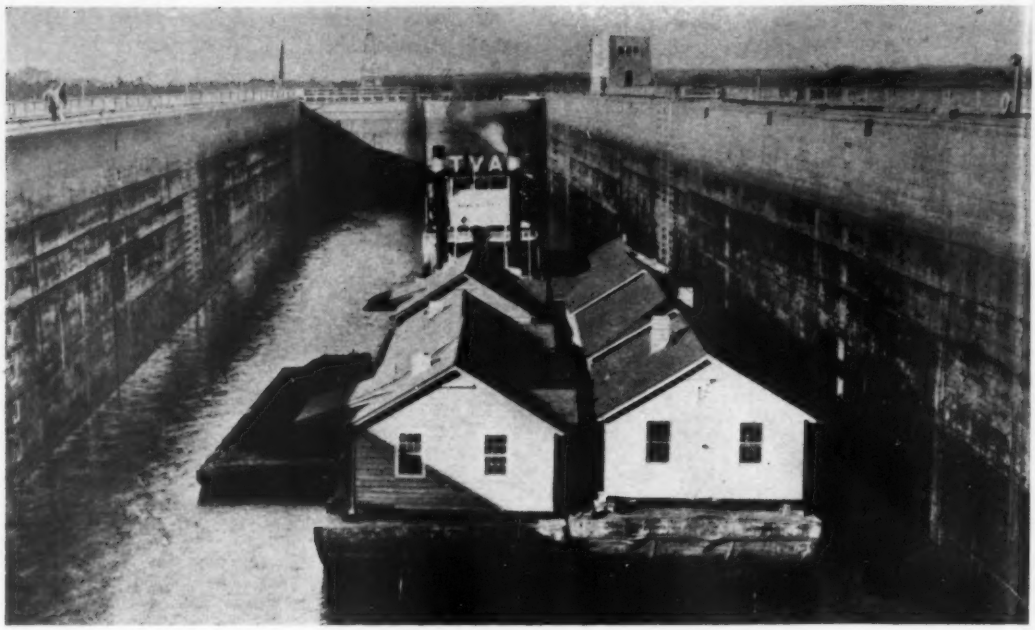
UPPER SCALE FOR CRUISING
LOWER SCALE FOR LANDING
THOUSAND FEET
HUNDRED FEET
TERRAIN CLEARANCE
POINTER SHOWS EXACT HEIGHT OF PLANE ABOVE EARTH READING DIRECTLY IN HUNDREDS OR THOUSANDS OF FEET AS DESIRED BY PILOT
NUMBERS CORRESPOND TO FULL-SCALE DEFLECTION OF POINTER
5000 FT.
1000 FT.
SWITCH ADJUSTS "TERRAIN CLEARANCE METER" TO GIVE COARSE OR FINE READINGS

Here the dial of the new instrument is set in a panel alongside that of the standard barometric altimeter. A switch, as shown at the left, gives a coarse or fine reading for the altitude

point on his chart, a pilot must also take into account the known elevation above sea level of that point. If he is uncertain of his location, he may misjudge his safety margin of altitude, and some of the major air disasters of recent years have been traced to this cause. In one case an airliner crashed head-on at full speed into a Utah peak that could have been cleared safely by flying only twenty feet higher! An accident like this would be impossible with the new radio probe. It also is free of other well-known drawbacks of barometric altimeters, including their susceptibility to weather changes that affect atmospheric pressure, and their tendency to lag behind when a plane changes altitude rapidly, as in landing.

MOUNTED side by side in an instrument panel for the recent flight test, the dials of a radio probe and a standard altimeter gave observers a striking comparison. Over the skyscrapers of New York City, the clock-like hands of the regular altimeter stood still, since the plane was flying a level course. But the pointer of the radio altimeter was dancing crazily across its dial. It was actually registering the distance from the plane to each of the rooftops below! Above the Hudson River, the pointer steadied at the figure shown by the altimeter—800 feet—but it dipped sharply for a moment as the plane passed over the high span of the George Washington Bridge which connects New York with New Jersey. When the airliner turned from the river and crossed the towering cliffs of the Palisades on the New Jersey shore, with the altimeter still showing 800 feet, the pointer of the radio probe dropped to less than half that figure. During the final landing at Newark Airport, the radio probe instantaneously registered the progress of the descent, while the barometric altimeter, lagging behind, was still dropping after the plane had come to rest on the runway.

Plans have been announced by the United Air Lines to make the radio altimeter standard equipment on all its ships, as soon as preliminary tests have been completed. The present experimental model, developed in collaboration with engineers of the Bell Telephone Laboratories and Western Electric Company after years of research, employs a five-watt transmitter operating from the plane's generator. It produces radio waves of the highest frequency ever employed for practical purposes—500,000,000 cycles or oscillations a second—and this ultra-high frequency is declared to make it immune to static. How the instrument times the return of these waves from the earth has not been revealed in detail, but the method is understood to be based upon interference between the reflected wave and a faint wave that passes directly between the transmitting and receiving antennas. In addition to its telltale dial, the radio probe may be equipped with a red warning light that will automatically flash on when the pilot descends below a predetermined safe height from the ground.

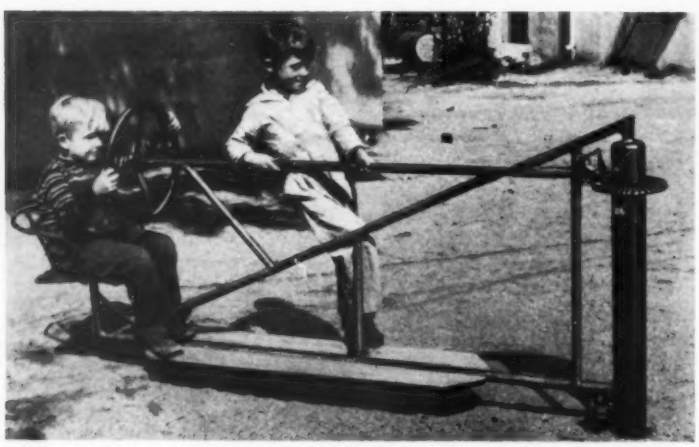


Town Is Moved 180 Miles on Barges

HAULED down the Tennessee River on barges, houses used by Tennessee Valley Authority workers at the Pickwick Landing Dam in Tennessee were recently transported 180 miles by water to the site of a new dam under construction near Paducah, Ky., where they were set up again on dry land for workers at that location. The photograph above shows a group of the dwellings on barges passing through a navigation lock.

Steering Wheel Turns Merry-Go-Round

TO GIVE his son outdoor exercise in the back yard, a southern California man devised the odd one-boypower merry-go-round pictured below. An automobile steering wheel is geared to the central standard by a long shaft. By turning the wheel to the left or right, the boy can swing the machine around.



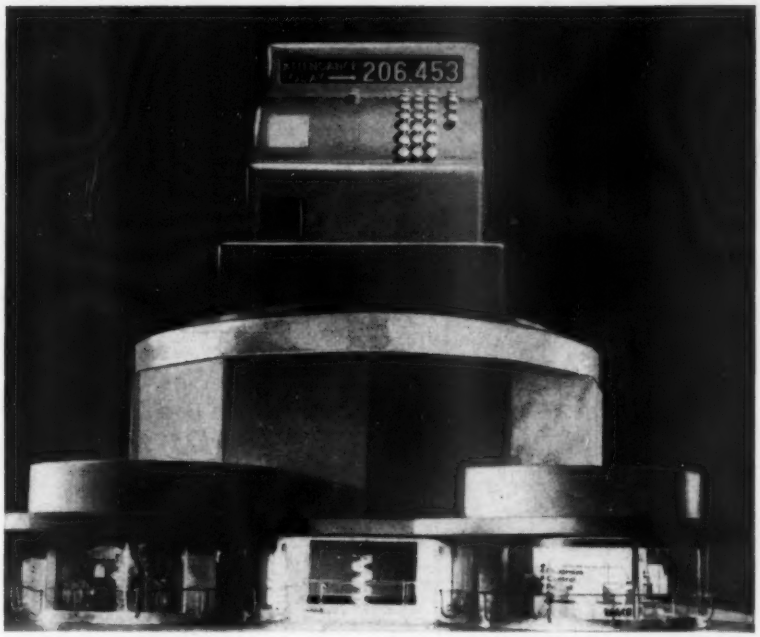
While one boy makes the carrousel go 'round, others can ride the platform

Shaving Soap in Celluloid Tube

SHAVING SOAP in granulated form is now available for the first time in a novel transparent tube made of celluloid, which allows the user to see at a glance how much of the powder is left.

Huge Register Will "Ring Up" Fair Visitors

TO TALLY the daily attendance at the World's Fair in New York City, a maker of cash registers is constructing the largest one in the world. As a visitor passes through the entrance gate, the forty-foot-high machine will "ring up" his arrival. Mounted on top of the company's exhibit building, it will revolve slowly upon a turntable so that its illuminated figures, of six-foot height, will be visible at all times both by day and night from every part of the fair grounds.



Daily fair attendance will be counted by this giant revolving cash register

Easy-To-Work Anchor Reel

WITH the aid of a new anchor reel for small boats, a six-year-old child can easily pull a twenty-pound anchor from a muddy bottom. By winding up the rope outside, the device keeps the interior of the boat clean and dry, and facilitates removing weeds entangled in the anchor, as illustrated in the photograph reproduced below.

How the reel keeps a dirty anchor line outside boat

Placed in a tire, it looks like a spike . . .

. . . but it's only a very clever rubber imitation

Rubber "Nails" Puncture Jobless Man's Problem

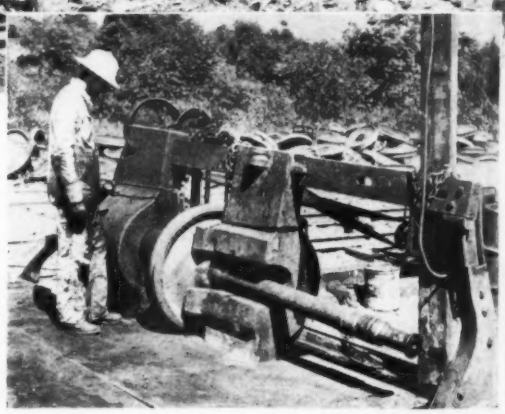
A FRIEND'S dismay on finding a large nail protruding from a brand-new auto tire gave a jobless Alhambra, Calif., man an idea that is earning him eighteen dollars a day. From scraps of go-cart tires, inner tubes, rubber cement, and aluminum paint, he concocted harmless rubber "nails" that can be pinched into the tread of a tire when the owner isn't looking. Practical jokers took to the scheme, and its originator is now manufacturing the "nails" to fill an order from a Los Angeles firm for 5,000 of the novelties.

Where Freight Cars Go When They Die

The end of the long run. This freight car is to be burned for its metal

A huge crane tips the wooden body off the heavy metal trucks

WHAT happens to railroad freight cars that have outlived their usefulness? The photographs on this page show activities in a freight-car graveyard where the wooden bodies are tipped off their wheel trucks, and set afire to burn off the wood, paint, and grease. This leaves the valuable metal parts exposed for recovery as scrap, of which each car yields some fourteen tons worth about seventeen dollars a ton. Cars are burned late in the day so that metal parts will be cool enough to handle by morning. In one scrapping plant alone, more than twenty cars can be dismantled in a day.

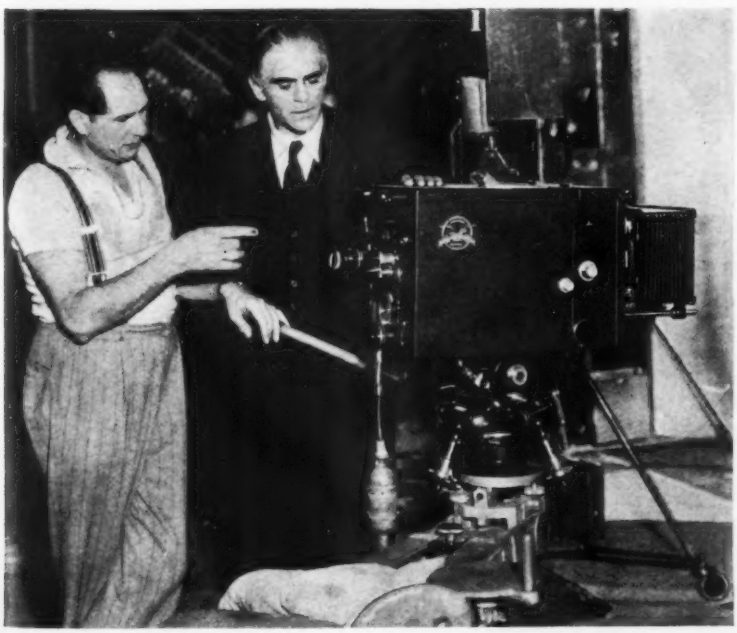


Wheels are pushed off their axles by this powerful press. Below is the funeral pyre in which old car bodies are consumed, leaving their skeletons of scrap metal worth nearly $250 apiece

Youngsters get a thrill as the futuristic "rocket ship" inflates their toy balloons

"Rocket" Tank Fills Toy Balloons

TOY BALLOONS are inflated to order, for children who visit the zoo in New York City's Central Park, with the aid of a rubber-tired wagon patterned after an imaginary rocket ship of the future. The device is provided with a valve like that of a drinking fountain, and its attendant simply presses a button until a balloon held over a nozzle is filled. A cylinder within the "rocket ship" contains compressed helium gas to make the balloons lighter than air.



Boris Karloff and cameraman examine the new lightweight movie camera

Movie Camera Has Novel View Finder

CALLED the first of its kind, a lightweight motion-picture camera just introduced in Hollywood tips the scales at ninety-five pounds, or less than one fourth the weight of most sound-tight models. One of its mechanical refinements permits the cameraman to view the scene directly through the film. This avoids difficulties that arise, especially in close-up work, from the difference in point of view between the lens and a view finder set at one side of the camera.

Blindfolded Men Train Dogs

THIRTY days of darkness—a month of eating, drinking, shaving, and working while blindfolded—is part of the unusual training given instructors at the Seeing Eye farm in Morristown, N. J. These men train the German shepherd dogs which now act as guides for the sightless in almost every state in the Union. It takes four months to train a dog, but it requires almost four years to school an instructor in all the branches of his highly specialized work.

The blindfolded training comes first. It enables a beginner to understand the problems of the sightless. During this period, he is guided about by one of the veteran dogs at the farm. Afterwards, years of classroom and practical training teach him the fine points of his unique profession.

Mealtime for future instructors at the Seeing Eye farm. A "month of blindness" is a part of their training

This dog is being trained to pick up anything that its companion drops. Starting with large objects, it learns to retrieve things even as small as a dime

Seeing Eye dogs are taught to disobey orders when it is necessary for the safety of their masters. Here a dog is refusing to approach an open manhole

for the Sightless

It costs about $900 to train a Seeing Eye dog. Only females are used, and the work begins when the animals are one year old. Dogs are taught to lead their companions through traffic, around open manholes, away from low awnings and other obstructions. They stop at each curb for their masters to step up or down. They disobey commands if obedience would lead their companions into danger. They are, in a word, eyes for the blind.

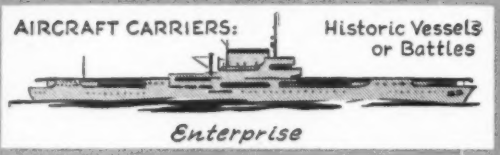
At the end of the dog's training period, the instructor dons his blindfold again and lets the animal lead him through city traffic. A second instructor, without the blindfold, follows to observe the actions of the animal under tests. Before a dog leaves the farm, its future owner spends a month or more at Morristown, becoming accustomed to its guidance.

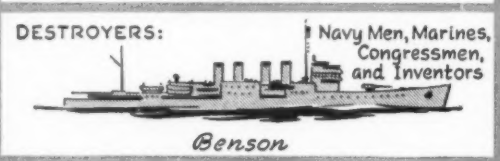
How successful is the work of these Morristown trainers is shown by the fact that, two years ago, a blind student at the University of California hitch-hiked his way from coast to coast without an accident, guided by his Seeing Eye companion.

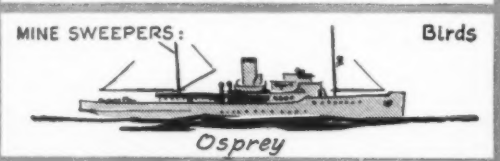
Examination day. Before a dog is "graduated," it must prove its reliability in actual traffic tests

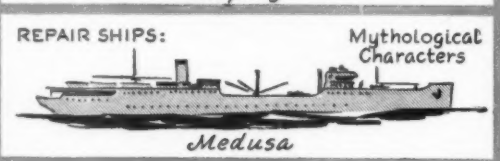
A trainer teaching his guide to stop at every curb. This warns a blind master to step up or down. At a corner the dog halts to be told which way to go

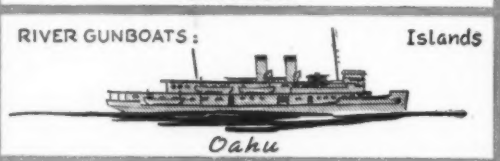
NAMING THE NAVY

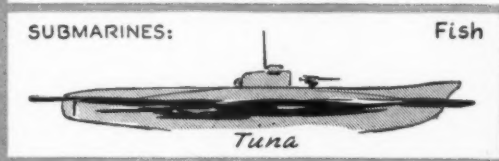


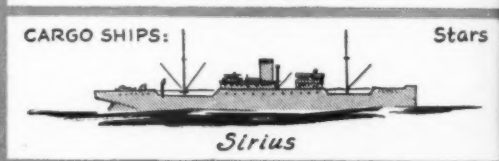


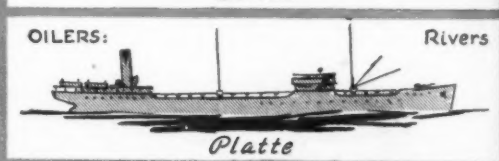


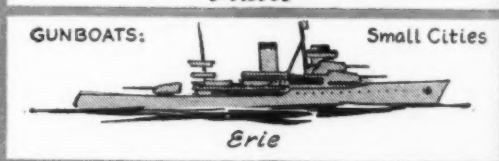


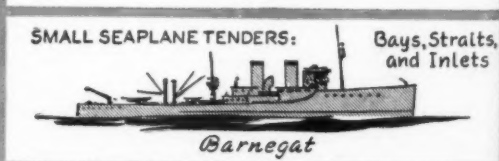


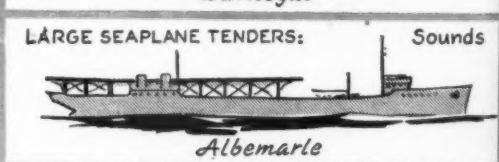












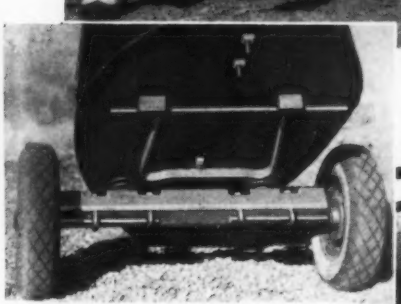
NAMING a baby is a minor problem compared with picking a name for a new U. S. warship. So the Navy Department has just announced its adoption of the standardized procedure illustrated here. Previous tradition will be followed as far as possible, as in naming battleships after states; thus the Navy's four projected 35,000-ton battleships will be known as the *Alabama, Indiana, Massachusetts,* and *South Dakota.* Rules have been added to cover new types of auxiliary vessels. These drawings show types of ships, sources chosen for their names, and typical examples.

Cooking Equipment and Radio Carried in Bicycle Trailer

Don Abrego with his homemade bicycle trailer. Note the radio antenna at rear

BECAUSE the amount of equipment that could be carried on a bicycle luggage rack was not sufficient for the camping trips Don Abrego, of San Diego, Calif., planned to take, he built the lightweight camping trailer shown in the photographs on this page. The trailer contains a one-tube radio, two-gallon water tank, two-burner gasoline stove, cooking utensils, and space for food. Well balanced, the two-wheel trailer is easy to tow behind Abrego's two-gear bicycle.

At the left, Abrego draws water from the two-gallon tank in the unit. There is space for food and utensils



Underside view, showing the axle mounting, springs, and parking stand. The trailer is towed easily

Here the young camper is listening to a radio program while he cooks a meal on the built-in, two-burner gasoline stove

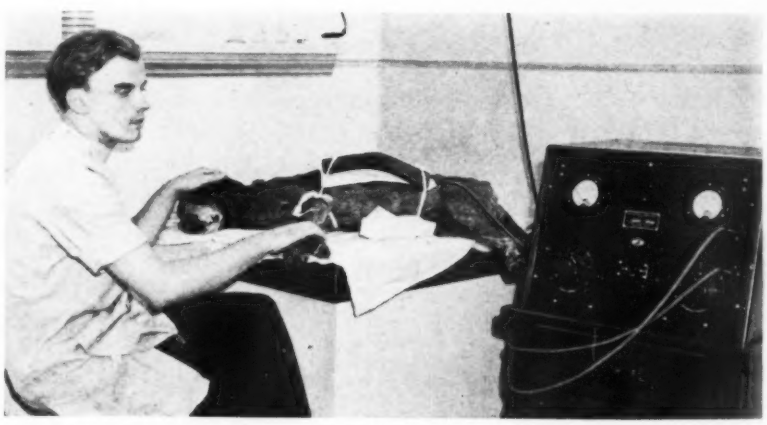
New Jobs

Beauty by radio. Through this weird mask, short waves are sent through the skin to remove facial blemishes

MANY people think of radio merely as the mysterious force that brings music and entertainment to the receiving sets in their living rooms. But scientists and inventors every day are finding new applications for this jack-of-all-trades, not only in its original field of communications but also for uses ranging from curing sick cattle to removing blemishes from women's faces.

When prize cattle on a California ranch were dying like flies in an epidemic of pneumonia, not long ago, the owners decided to take a long chance. They had heard about radio waves being used to treat similar ailments in human beings; it might work on cows. Hastily procuring the necessary apparatus, they sent high-frequency waves coursing through the lung areas of the animals. Five days later, all the cattle were practically well.

Radio is even being put to use by the chemists. French scientists have found that many chemical reactions can be speeded up by shooting radio waves through copper coils that form nests for the test tubes or flasks containing the reagents. This process even brings about some reactions that otherwise would not occur at all.



Radio is being used extensively for the treatment of animal diseases. Here a dog is being cured with a special apparatus

● **SCIENTIFIC JACK-OF-ALL-TRADES FINDS ODD USES,**

for Radio Waves

More romantic is the use found for radio by a beauty shop in Hollywood, Calif. To remove pimples, skin blotches, and other facial blemishes, a weird-looking mask is clamped over the customer's face. When a switch is thrown, high-frequency waves flow through the skin.

When the Baltimore & Ohio Railroad suffered loss through insects infesting stored grain, an electrical engineer brought short waves into play against the pests. He found that radiations sent through the grain quickly destroyed the insects.

Pet hospitals are making extensive use of short waves in treating dogs and cats for ills that range from sore throats to bone bruises.

Lee De Forest, famous pioneer radio inventor, has been carrying on experiments to test the value of these radiations in curing sprains in horses.

Lee De Forest, famous inventor, testing the effect of radio on a strained tendon in a horse's leg

Looking into the future, radio promises even more amazing things. According to one dental expert, it will not be very long before radio waves will be used as a cure for toothache. An eastern poultry raiser, experimenting with the effect of radio entertainment on the egg production of his hens, prophesies that chickens as well as cows on the farms of tomorrow will be spurred to greater efforts by loudspeakers that blare the music of a "swing" band.

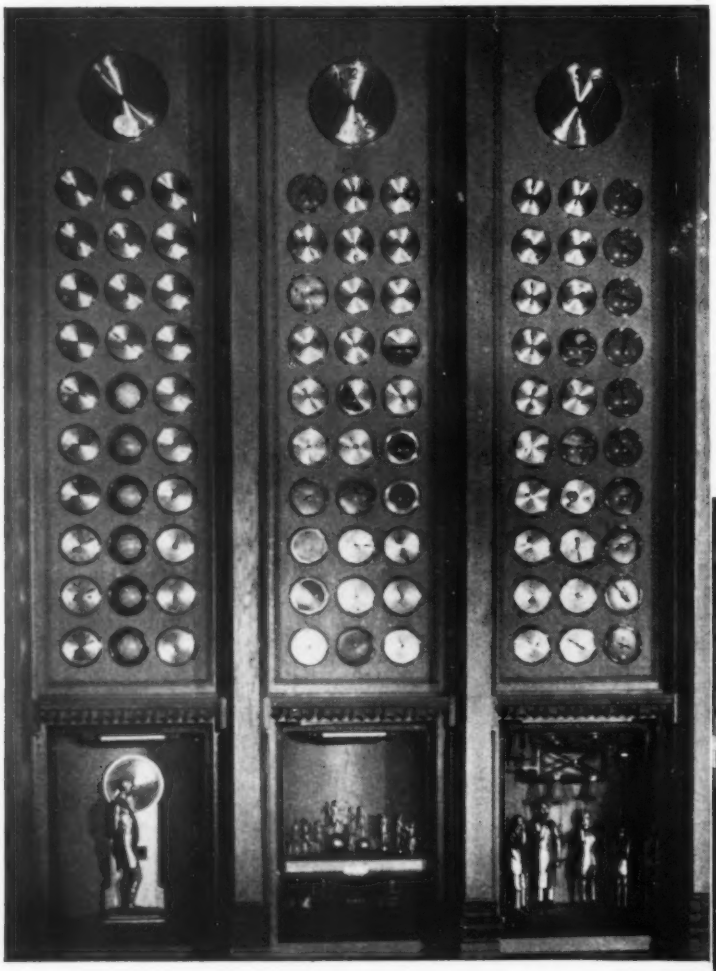
Delegates and reporters at an international conference heard the speeches through short-wave receivers

FROM CURING COWS TO MAKING WOMEN BEAUTIFUL ●

Buys the Blarney Stone — Ten Tons of It

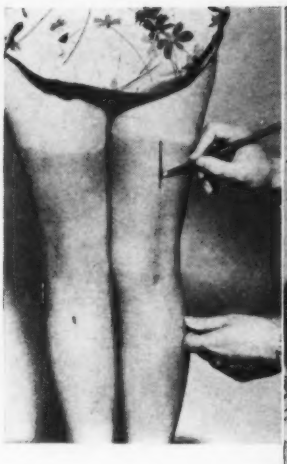
WHEN Manfred Meyberg, of Los Angeles, Calif., jokingly ordered an Irish friend to buy the Blarney stone for him, he got more than he bargained for. What he meant was the famous stone in the wall of Blarney Castle, Ireland, which is supposed to bestow the gift of gab on anyone who kisses it. To his surprise, his friend responded by notifying Meyberg that he was shipping 20,000 pounds of rock from the Blarney quarry, from which the famous stone presumably came. At the right, Meyberg is letting an American colleen test a chunk of it.

Mammoth Clock Has Ninety-Three Dials



"Face" of the giant clock. At the right, the builder points to an indicator that moves at the rate of one revolution in 26,000 years

NINETY-THREE dials dot the face of a sixteen-foot, 450-pound clock constructed by Lodewyk Zimmer, clockmaker to the King of the Belgians, and now on display in New York City. Electrically controlled by one master movement, the giant timepiece records astronomical changes, tides, world-wide time, and other data. The indicator on one dial moves at the rate of one revolution every 26,000 years. On another the needle whirls around 100 times a second.



Make-up that looks like real silk is applied to the legs with a sponge. Seams and clocks are then drawn in with a special cosmetic pencil

Make-Up "Stockings" Can't Run

MAKE-UP takes the place of silk in novel stockingless hosiery recently developed by a Hollywood make-up expert. A specially made preparation, applied with a damp sponge, is spread thinly and evenly over the bare legs. When it dries, the substance is said to be almost identical in appearance with sheer silk hose. To increase the realistic effect of the runless, wrinkleproof "hose," a seam is penciled down the leg with another special make-up material. Though it may be removed easily with soap and water, the stocking cosmetic will not come off on clothing and will not run or cake from the effects of perspiration, the makers claim.

Laying airplane runways of cotton at Reilly Field to test its efficiency

Airport Tests Cotton Runways

AIRPLANES are now taking off and landing on cotton runways at Reilly Field, Fort McClellan, Ala. As an experiment to determine the efficiency of cotton as a base for hard-surfaced roadways, large quantities of the material in the form of a woven cloth were laid down on the airport on an underlying base of tar. The cotton was then covered with asphalt and rolled down to form a smooth, even runway surface.

Family "Bicycle" Carries Nine

In this Swiss family, there's never any fuss about who gets to use the family bike today

A CYCLING enthusiast of Dnedingen, Switzerland, takes his family on Sunday outings on a "bicycle" built for nine. His curious vehicle, which has four bicycle-type wheels, is pedaled by the man, his wife, and their three older children, while the four younger offspring bounce happily along on the wide rumble seat built over the rear wheels. The two front riders guide the contraption by means of steering wheels like those used on automobiles.

Camera Car Gets Dope on Fast Drivers

TO CHECK UP on the safety with which truck and private-car operators drive, a large insurance company has furnished its investigators with a novel photographic test car. A camera is mounted just above the windshield of the automobile and aimed so that it will snap not only the car being followed but also a special speedometer attached to the test car's left front fender. A button on the steering wheel controls the camera shutter. An example of how the arrangement works is pictured at the left. Checking up on a truck, the inspector has snapped the test-car camera to show that the truck driver was going sixty miles an hour past a warning sign which plainly limits speeds on this particular stretch of road to thirty miles an hour.

Photographic evidence against a speeder

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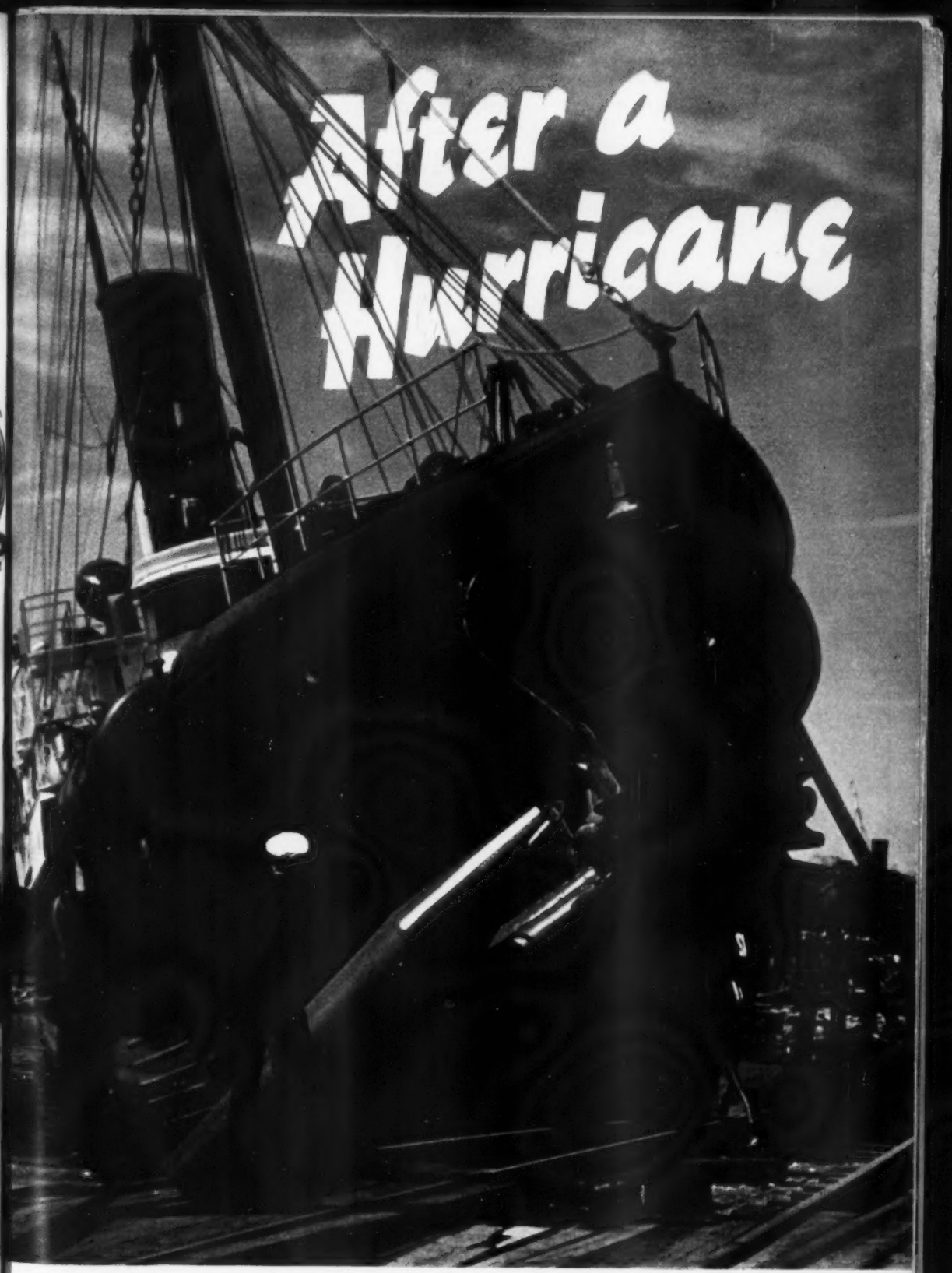

Color Pictures By Our Flying Photographer Show
How Relief Forces Mobilize When Disaster Strikes

U.S. Coast Guardsmen loading a Lyle gun in preparation for shooting a temporary telephone line across a river

Fire! The projectile whizzes away, dragging the light line that will haul electric wires across

Rescue workers search for Saltaire, a hard-hit resort c

By RUDY ARNOLD

Color Photographs by the Author

SWINGING like a scythe across six northeastern states, recently, a freak hurricane mowed down whole villages, hurled waves three stories high at the shore, felled billions of feet of timber, and left behind 682 persons dead, 10,000 families in want, and damage far in excess of $50,000,000. During the sixty hours that followed, I was working at top speed, racing from scene to scene by plane, car, and boat, photographing for POPULAR SCIENCE MONTHLY the whole dramatic activity of an army of relief workers that battled want, hunger, and suffering in the wake of the whirling winds.

During the night of September twenty-first, the hurricane blew itself out. At dawn, the next morning, I was loading my color camera and climbing into the cabin of a red and black Waco biplane at Floyd Bennett Field, New York City. With a friend of mine, "Rip" Strong, at the stick, we lifted from the soggy airport and headed east. The Coast Guard base, at the far side of the field, passed below us. It was a beehive of activity. Mechanics were wheeling planes from the hangars. Pilots were preparing to fly serums, food, and medicines into the stricken area. A giant silver flying boat was sliding into the water for a flight up the coast.

Traveling at two miles a minute, we soon crossed the trail of the great winds. Acres of trees were scattered about like matchsticks. Automobiles were lying on their sides, half buried in sand. Houses were flattened out as though they had been crushed under steam rollers. Near the far tip of Long Island, we glimpsed a coupe half submerged in water.

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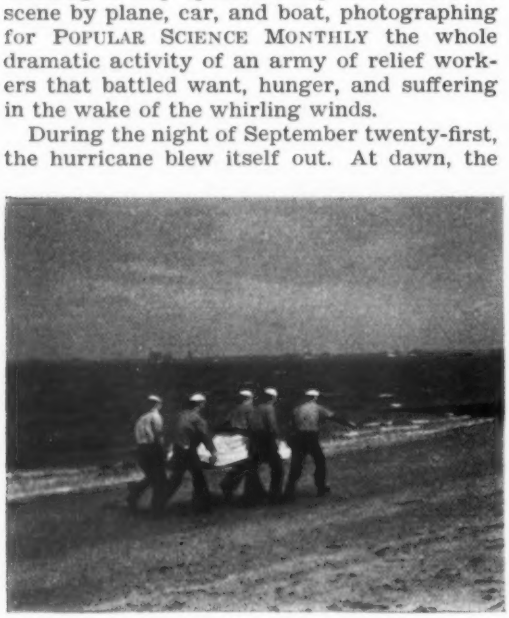
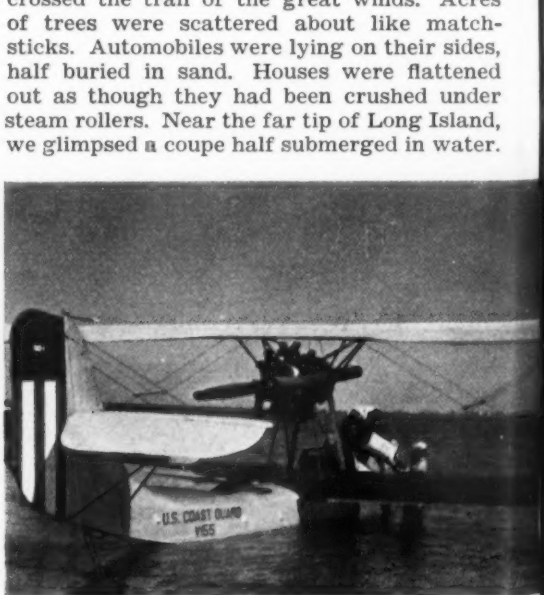


Coast Guardsmen rushing a survivor to an ambulance. Prompt attention was necessary to keep exposure and disease from claiming more lives



Winged messenger of mercy—a Coast Guard plane tak
ing on a load of serum to be flown to the stricken cit
of New London, Conn., for use in fighting disea

A state policeman helping
at the right shows the houses
munity whirled together in a

for survivors in wreckage at
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All Coast Guard men were inoculated against typhoid before going on relief duty

Looking for bodies in wreckage strewn along the shore. Such scenes were common on the battered Long Island coast

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Looking for bodies in wreckage strewn along the shore. Such scenes were common on the battered Long Island coast

This surfboat is being taken acro the place where it will be put int

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we reached New London,
our goal.

rywhere I turned, in this
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ture. National Guardsmen
patrolling the streets; WPA
were searching wreckage
ctims; Red Cross workers
setting up feeding stations
jecting serums against ty-
and tetanus; Coast Guard
nacists were testing the
of drinking water. For
my camera was busy. Then
arted back for New York.

With traveling conditions better, we reached home early in the afternoon. I had hardly eaten since the morning of the day before and I was groggy from lack of sleep. But, I had a dozen rolls of color pictures. They, however, did not tell the whole story. So, as soon as I could get a sandwich and a fresh supply of Kodachrome film, I climbed aboard the Waco for what proved to be the most exciting trip of all.

At the start, we cut across Long Island and swung up the New England coast along the route we had followed by car. Now, we saw the full effect of the hurricane. At one spot, nearly fifteen houses were whirled together as though they had been in the grip of a giant egg beater. At another place, a yacht was resting on a front lawn with a five-foot hedge between it and the sea. Near Madison, Conn., there was the strangest sight of all—a two-story

Here food is being loaded abo
Fokker flying boat of the Coa

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Here food is being loaded aboard a big Fokker flying boat of the Coast Guard

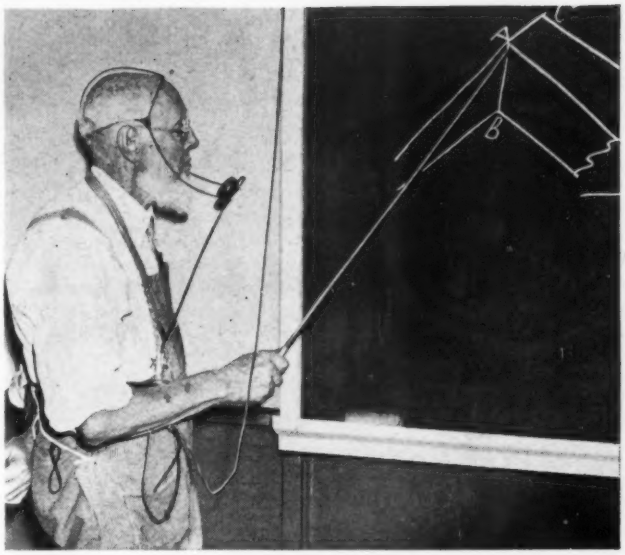
Setting up a crude field laboratory, a relief worker tests water for drinking

Blocks containing storm warnings. Planes drop them on boats that have no radio

I was shooting pictures at various heights, from 1,200 to 150 feet, and with the Waco traveling between 100 and 120 miles an hour. Fifteen miles from New London, we could see smoke still rising from the fires which had broken out along the waterfront after the hurricane. With the ship cutting back and forth over the ruins, I snapped picture after picture of the wreckage below. Coast Guard boats were plowing through the debris floating in the harbor. At one point, a giant lighthouse tender had been thrown on land and was blocking a railroad track.

The air was boiling. Our ship rocked and pitched. Suddenly, just as I was aiming my Contax camera, the Waco stood on one wing. Its 285-horsepower engine bellowed and we veered in a vertical bank to the left. Just in time, the pilot had looked up and seen another photographic plane slanting down directly overhead. Another minute and we would have crashed in mid-air. That decided us. The air was getting too thickly populated. I had all the aerial shots I needed, so we headed home.

The following day, I went by car and Coast Guard boat to Fire Island. Here, my color camera completed its record of the swift and varied activity which was bringing relief to victims throughout the whole area where winds had run amuck.



"Mike" Headgear Aids Teacher

TO MAKE himself heard above the noise of lathes and hammers, J. H. Henika, instructor in woodworking at the Georgia School of Technology, in Atlanta, uses an amplifying system and a portable microphone mounted in a novel headgear that supports the mike in front of his lips, no matter which way he turns his head. The connecting wire is attached to an overhead trolley so that the instructor can walk about the shop.

Transparent Mail Box

ONE glance at a new mail box now available will tell whether the postman has left any letters, for the novel receptacle is made of transparent, tempered glass. Equipped with stainless-steel fittings, the glass mail box will look like new indefinitely, it is said.

Now it's easy to see if there's any mail

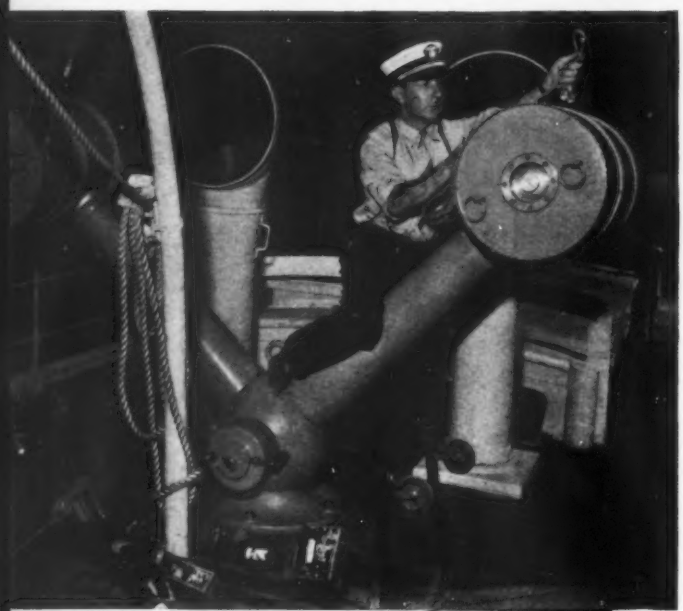
Metal Highway-Lane Barrier Keeps Autos in Line

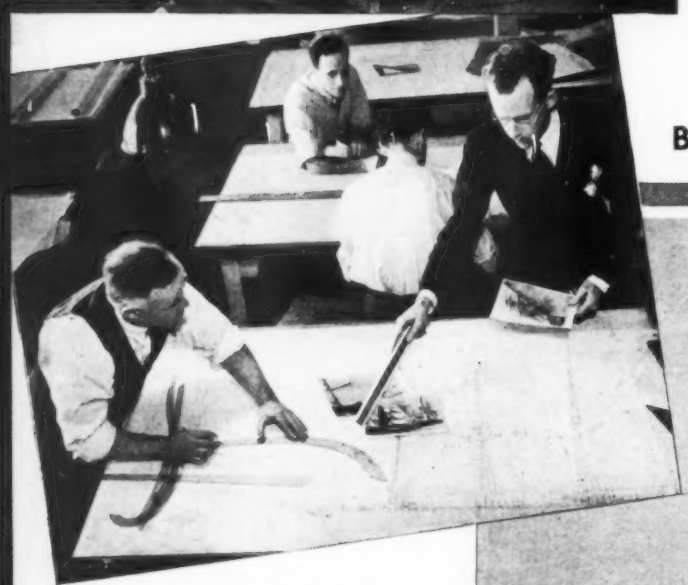
Front and side views of a test car trying to cross the highway-lane barrier. Sloping steel walls force wheels back into line

TO PREVENT head-on automobile collisions on multiple-lane highways, a center-line metal barrier has just been invented. Shaped like an inverted V, the sloping barrier is made of fabricated sheet steel, eighteen inches high and thirty inches wide at the base, capped by a vertical section with rounded, overhanging sides. Recent tests have shown that an automobile crowding into the barrier is automatically turned back by the sloping sides without injury regardless of its speed.

Hollywood's Phantom N

MOVIE SHIPYARD BUILDS VESSELS THAT NEVER PU





Studio draftsmen laying out plans for a schooner. Above, Christensen with a dummy depth bomb on a sub chaser

●

At the right is a realistic battle scene between miniature ships, with some of them afire

LASHED by wind and wave, sturdy ships roll and pitch across the screen of your movie theater, or lie at anchor in picturesque ports of make-believe. They are the phantom fleet of Hollywood —mighty barks, speedy submarine chasers, ancient slavers, men-o'-war, sloops, schooners, and brigs. In most cases, they float on shallow tanks, or maneuver on hydraulic jacks or steel balls on studio sound stages and outdoor sets. And the majority of them are creations of a modest Dane named Chris Christensen, who holds a unique position as shipbuilder to the silver screen.

Sixteen years ago Christensen retired from the sea to seek a less adventurous life ashore. He went to California, and one day, after walking eight miles from Los Angeles to a Hollywood studio seeking work, heard a casting director call for a man who could splice rope.

As a youth in his native Aalborg, Denmark, Christensen had learned to perform every task on a sailing vessel from forecastle head to sternpost. He stepped forward and got the call. That simple job launched him on one of Hollywood's

By ANDREW R. BOONE

Navy

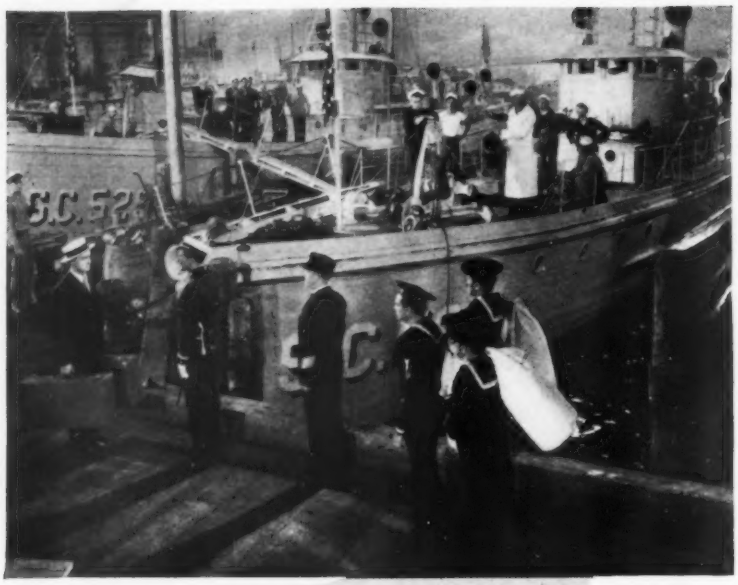
PUT OUT TO SEA

strangest and most exacting careers.

Usually he reproduces old ships for historical pictures, but sometimes he re-creates modern boats in complete detail. He thinks nothing of being awakened at midnight with an order from the studio to have a three-masted bark "ready on stage 10 in eight days." Next morning he lays out the plans, three crews of carpenters start construction, and a week later Christensen has the boat sawed into a half dozen sections or split lengthwise and hauled through the large doors onto the stage where he bolts it together again.

A recent order called for a pair of submarine chasers duplicating those of Uncle Sam's mosquito fleet of World War days. "Complete with three-inch and 'Y' guns," the order read. "And they must float on an even keel."

Christensen visited San Pedro and San Diego, obtained Navy specifications, borrowed guns and mountings, patterned "Y" guns and ash-can depth bombs after those wartime weapons, and laid out a tank thirty-five feet wide by 180 feet long. In the studio



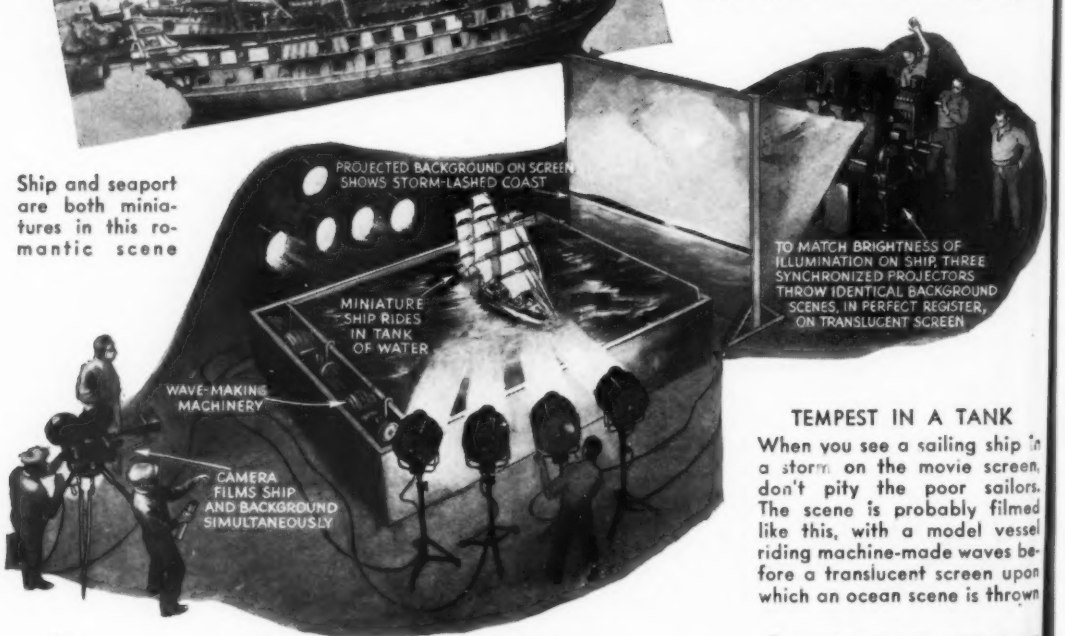
Phantom sub chasers floating in a tank against a background that represents the Brooklyn Navy Yard

carpenter shop, he directed the building of six pontoons, open at the top. Four days later, a crane lifted the pontoons through the door into the tank. Then a crew of workmen bound the pontoons together, built a hull around them, completed the superstructure, and shortly scenes for "Wooden Anchors" were being filmed, showing the two chasers tied up alongside docks at the Brooklyn Navy Yard.

"Empty, these boats drew only eight and a quarter inches of water, and they were as level as a concrete floor," this master marine technician tells you proudly. "We piled 11,000 pounds of equipment on each, and even when twenty-seven actors crowded one rail, the chaser listed scarcely five degrees."

Using a different method, the builder of boats that never sail recently completed at a cost of $5,000 a German U-boat in a single piece. From photographs

Ship and seaport are both miniatures in this romantic scene


PROJECTED BACKGROUND ON SCREEN SHOWS STORM-LASHED COAST
TO MATCH BRIGHTNESS OF ILLUMINATION ON SHIP, THREE SYNCHRONIZED PROJECTORS THROW IDENTICAL BACKGROUND SCENES, IN PERFECT REGISTER, ON TRANSLUCENT SCREEN
MINIATURE SHIP RIDES IN TANK OF WATER
WAVE-MAKING MACHINERY
CAMERA FILMS SHIP AND BACKGROUND SIMULTANEOUSLY

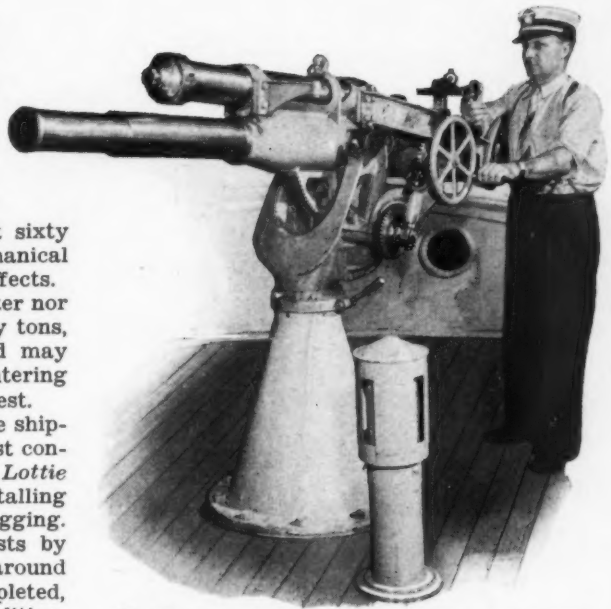
TEMPEST IN A TANK

When you see a sailing ship in a storm on the movie screen, don't pity the poor sailors. The scene is probably filmed like this, with a model vessel riding machine-made waves before a translucent screen upon which an ocean scene is thrown

and memory he laid out the long craft, building it in a shallow outdoor pool covering nearly an acre. All wood except guns and hatches, where fidelity of detail and sound required metal, the long, black underwater craft sprang into being in six days. Later, when it sneaked into an enemy cove for supplies in a movie scene, the sub moved along a wooden track a scant sixty feet while wind machines and mechanical agitators supplied waves and storm effects.

Many movie ships neither ride in water nor roll on tracks. Weighing perhaps sixty tons, these pitch and roll and wallow, and may appear to cover thousands of miles, entering ports as far apart as Calcutta and Brest.

Take the slave ship, for instance. The shipbuilder undertook a double job here, first converting the twentieth-century schooner *Lottie Carson* into a seagoing slaver by installing fake fighting tops and altering the rigging. He obtained the effect of shorter masts by bolting crosstrees to collars clamped around the masts. When the picture was completed, he restored the ship to her original condition, and once more she sails the seven seas.



Christensen gets his properties from many sources. Here he has a small gun borrowed from the navy

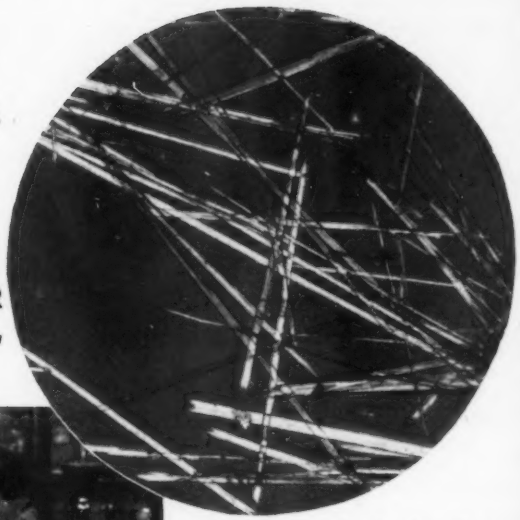
For studio sequences, the slaver's double sat on a platform, acting very much as though a storm would tear her to pieces. Christensen constructed the stage ship in a single piece and bolted her to the platform, which was mounted on a single, large ball resting on a steel plate. From his position at one side, he watched a storm unfold on a process screen and directed four men stationed at hydraulic jacks as they caused the prop vessel to twist and pitch.

Whether the script calls for a cabin cruiser, galleon, schooner, or war vessel, this specialist in ships can turn out the completed job from supplies he has collected during a decade of intensive building. In the studio property rooms are no fewer than twenty-five steering wheels of several sizes; hundreds of miles of rope, ranging in circumference from one quarter to fourteen inches; 500 belaying pins; clamps, cleats, chucks, compasses, engine room telegraphs, navigation instruments; and forty spruce masts, some sixty feet tall.

Cameramen take to the rigging to photograph scenes aboard a ship rebuilt by Christensen to represent a three-masted bark

Vitamin A Crystals

MAY MAKE YOUR DRIVING SAFER BY PREVENTING "NIGHT BLINDNESS"



Photomicrograph showing the vitamin A crystals, recently isolated by Dr. Harry N. Holmes. He is seen at work at the left with his laboratory assistant

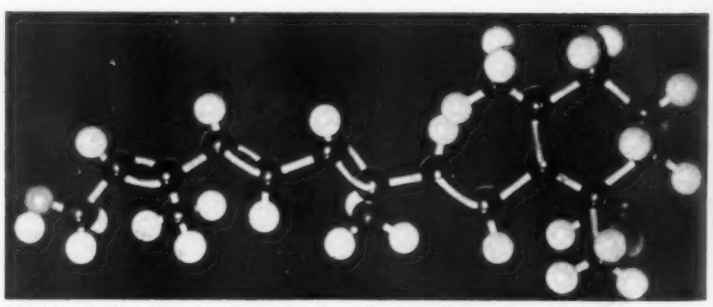
By WALTER E. BURTON

SO FUGITIVE that its pale-yellow, needle-shaped crystals must be kept on dry ice to prevent them from melting away, the first vitamin A that anyone has ever seen has just been isolated from fish-liver oil by Dr. Harry N. Holmes of Oberlin College in Ohio. His chemical feat promises surprising practical applications, among them that of making night driving safer.

For years it has been known that tiny amounts of vitamin A, in foods such as egg yolks and spinach, aid growth and increase resistance to germ infection. Recently a curious type of temporary "night blindness" among motorists, which has caused numerous accidents after dark, has been traced to a lack of vitamin A in the diet.

More knowledge of how vitamin A acts on the body would therefore help to improve our nighttime vision, as well as to promote general health. But research workers until now have been handicapped by the necessity of making tests with impure concentrates of the vitamin. Dr. Holmes's new process provides the pure crystals needed to make their experiments more reliable.

The isolation of vitamin A already has made it possible to find what that vitamin is made of. As illustrated by a model using different-colored spheres that Dr. Holmes exhibits, it turns out that a molecule of the strange substance consists of carbon, hydrogen, and oxygen atoms, in a proportion expressed by the chemical formula $C_{20}H_{30}O$.



Model of the vitamin A molecule. Black balls represent carbon atoms, white balls the hydrogen atoms, and single gray ball the oxygen atom

Direction Finder Is Automatic

AN AUTOMATIC direction finder for aircraft, recently announced after months of intensive flight tests, is a new aviation safeguard for blind flying. Actuated by a radio receiver employing a directional loop antenna, the new finder, unlike older models, does not require continual adjustment. An indicator needle on a dial mounted horizontally in the plane cockpit points continuously in the exact direction of the transmitting station to which the instrument has been tuned. The direction finder is expected to be of value in supplementing radio-beam apparatus.

Directional loop antenna of the new automatic blind-flying aid. Right, instrument dial in cockpit. Needle always points to the station tuned

Giraffes Make Trip in "Rubberneck" Truck

TO TRANSPORT two giraffes, recently imported from Africa, from the eastern seaboard to their new home in the San Diego, Calif., zoo, the odd rubberneck truck body shown at the left was specially constructed. It took keepers two days to lure the giraffes into the odd vehicle before they could start on their cross-country jaunt.

Two giraffes ready for their transcontinental trip in a truck. It took two days to lure them in

Inexpensive Hand Loom Speeds Up Knitting

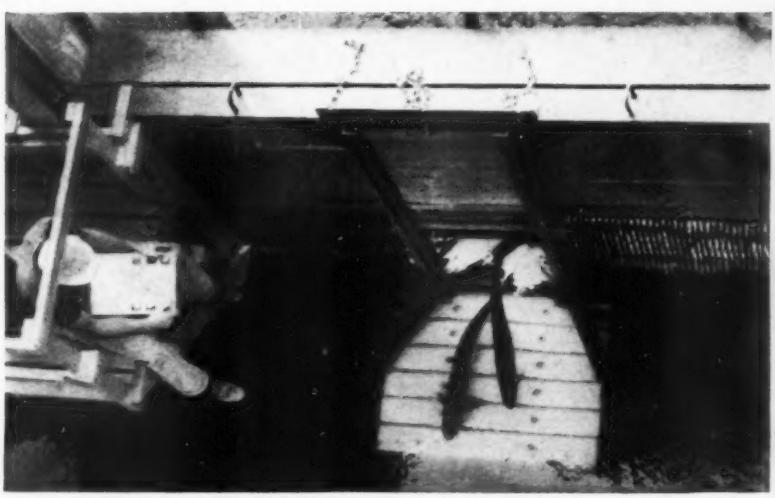
MORE than doubling the speed with which garments can be knitted by means of conventional needles, a hand loom recently invented is said to require but little practice for efficient operation. Three and a half inches wide and thirty-two inches long, the loom consists of two sections which can be spread apart by means of slotted metal plates that are locked with thumb screws. Yarn is looped back and forth along numbered pegs on each half of the loom, and then a pick resembling a crochet hook is employed to lift the yarn loops over the various pegs as the knitting process progresses. A counting device keeps track of the rows knitted. A detailed view of the pick loom is shown in the inset above.

Automatic Rifle Has Odd Design

BULLETS are fed into a new rapid-fire automatic rifle, issued to German infantrymen, from a circular cartridge chamber that juts out from one side of the gun barrel, as pictured in the photograph above. Packed in spiral fashion within the metal cartridge chamber, the bullets move automatically into place in the gun breech when the trigger is pressed, thus making the rifle serve as a lightweight machine gun that can be carried by advancing infantry like an ordinary rifle.

Census at Big Dam Gives Check on Spawning Fish

TO DETERMINE whether the Bonneville Dam on the Columbia River in Oregon is cutting down the number of salmon that swim upstream to spawn in the headwaters of the river, U. S. Government agents are now conducting a salmon census. Seated on a platform overlooking gateways in the dam, observers constantly count the salmon as they swim through, outlined above square white boards.

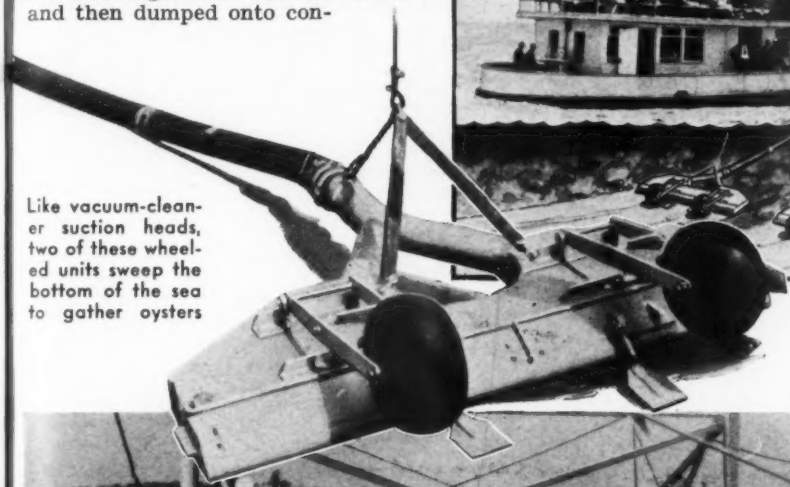


Fish swimming over the white flashboard are easily spotted by the census taker

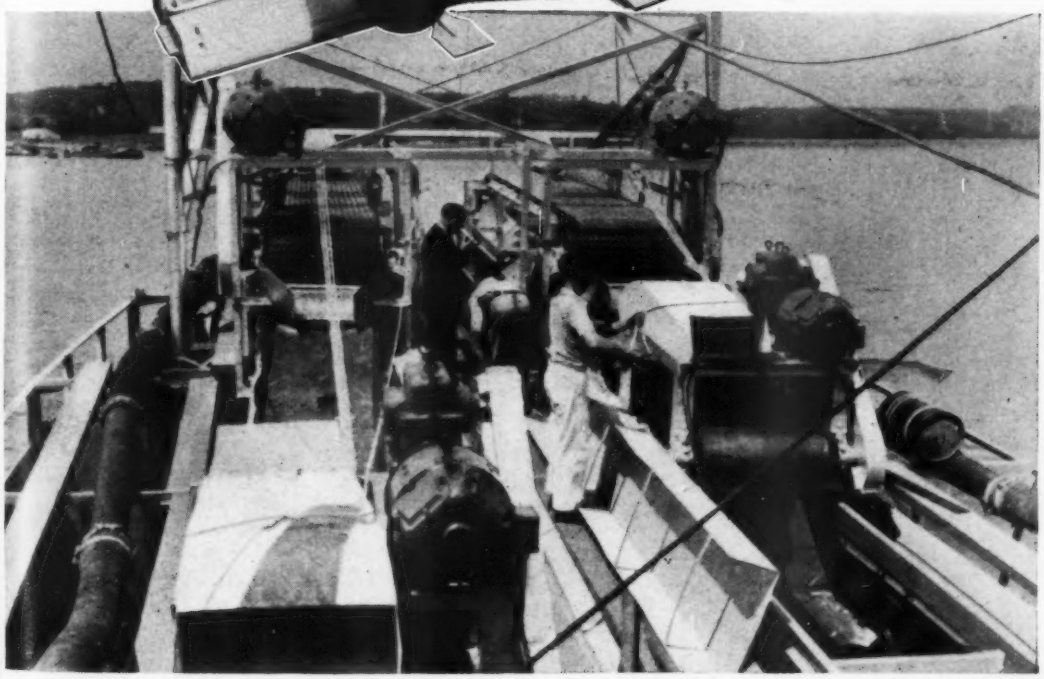
Oyster Boat Is Giant Vacuum Sweeper

HARVESTING oysters by sucking them up from the oyster beds, a floating vacuum sweeper has just been put into commission on Long Island Sound. While the dredge *Seawanhaka* is cruising at three knots, workmen lower over the sides two suction heads, ten feet wide and shaped like those used on conventional household vacuum cleaners. As these roll over the oyster beds on huge airplane-type tires, vacuum pumps draw the shellfish up to the deck through flexible pipe lines. There, the oysters are discharged onto screens, washed, and then dumped onto conveyor belts that carry them to storage bins. By providing a continuous loading operation, the vessel is able to harvest many times as much as older and smaller craft that drag chain-mesh bags over the beds. Details of the curious oyster harvester are pictured in the photographs on this page.

How the oyster dredge "Seawanhaka" drags her sweepers on sea floor



Like vacuum-cleaner suction heads, two of these wheeled units sweep the bottom of the sea to gather oysters



On her top deck, the "Seawanhaka" carries this elaborate machinery. Oysters drawn up to it are first washed, then dumped on conveyors shown in background, which carry them to storage bins in the hold

AMAZING
Stop-Action Photographs
MADE BY STUDENT ENGINEER

At top, Frank Wyle preparing to photograph a drop hammer in action to detect flaws in its design. His "flash gun" produces 5,000,000 candlepower for 1/50,000 of a second. Above, placing microphone to set off a flash

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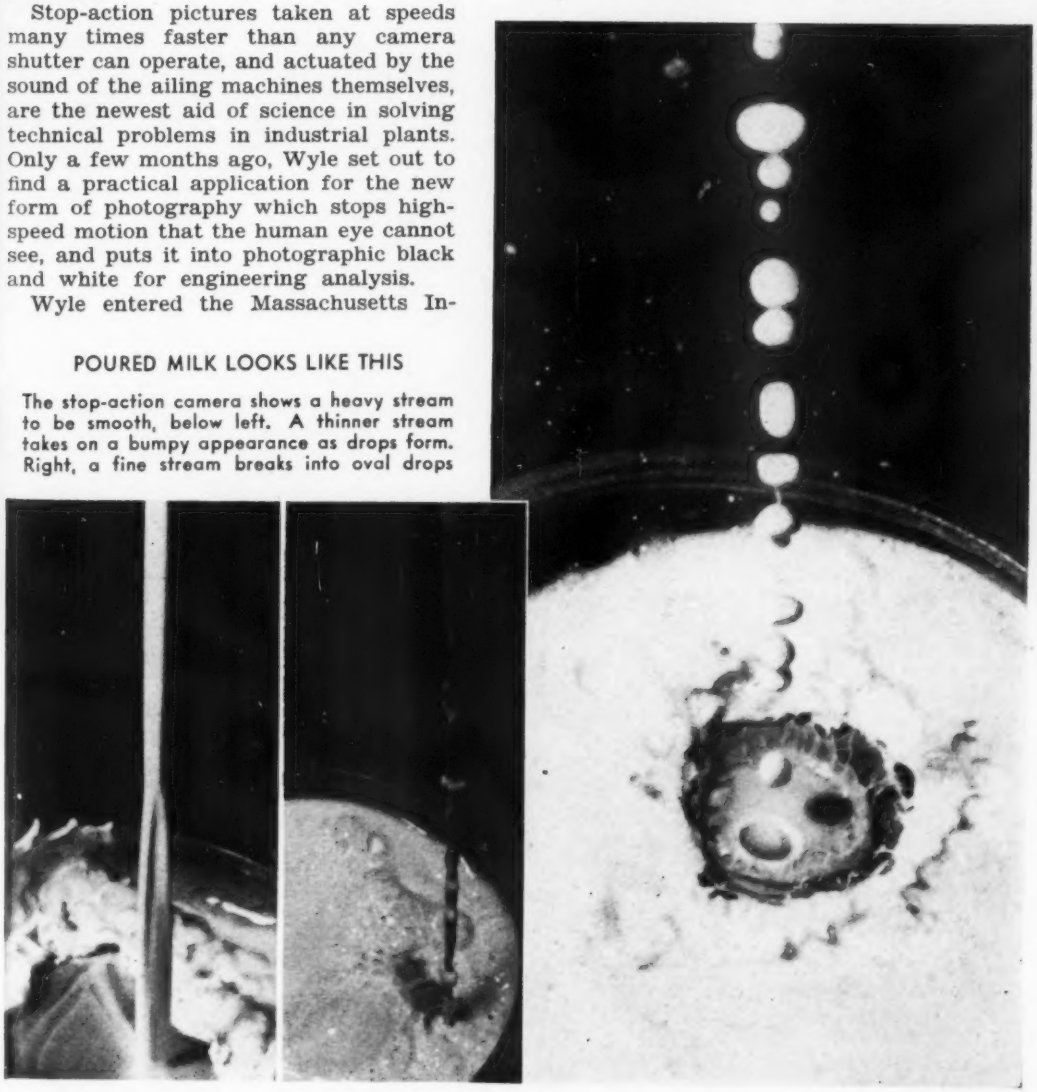

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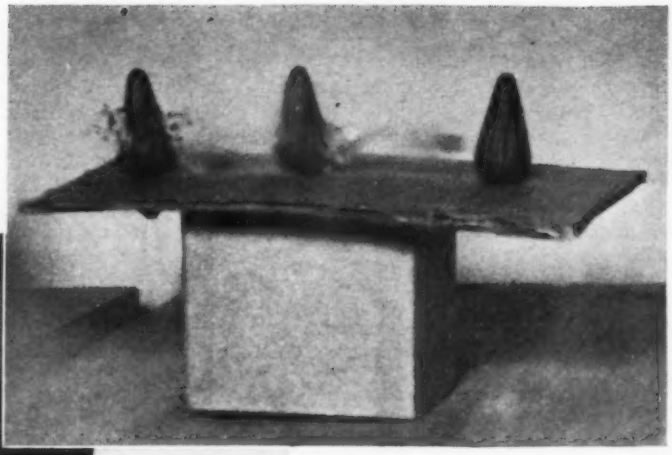

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SOUND-ACTUATED pictures promise much for industrial purposes. Here the picture is snapped when the carbon mike transmits a voltage which is amplified to 400 times the input, to set off the flash. For delayed flashes, the mike is moved farther away from the source, to take advantage of the time required for sound to reach the microphone. Early in his sound experiments, the young photographer set up his apparatus in the garage of his home, and first placed the mike near a gun. The picture was snapped before the bullet left the barrel. Again, he tried placing the microphone out of doors. The results showed improvement. Recently, he installed a microphone on a plate

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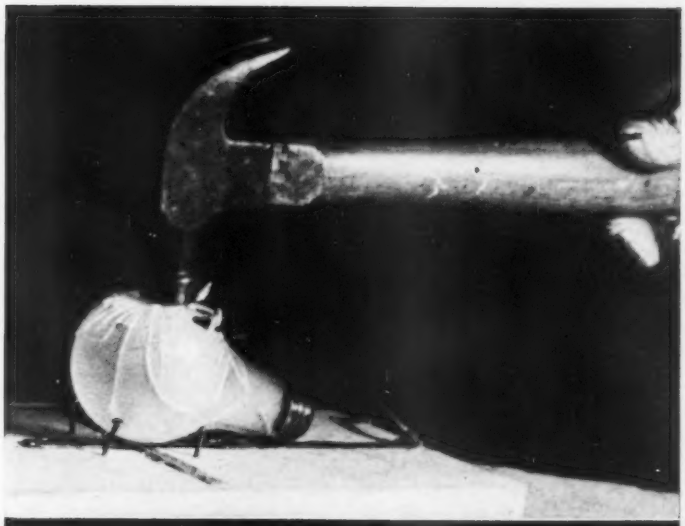

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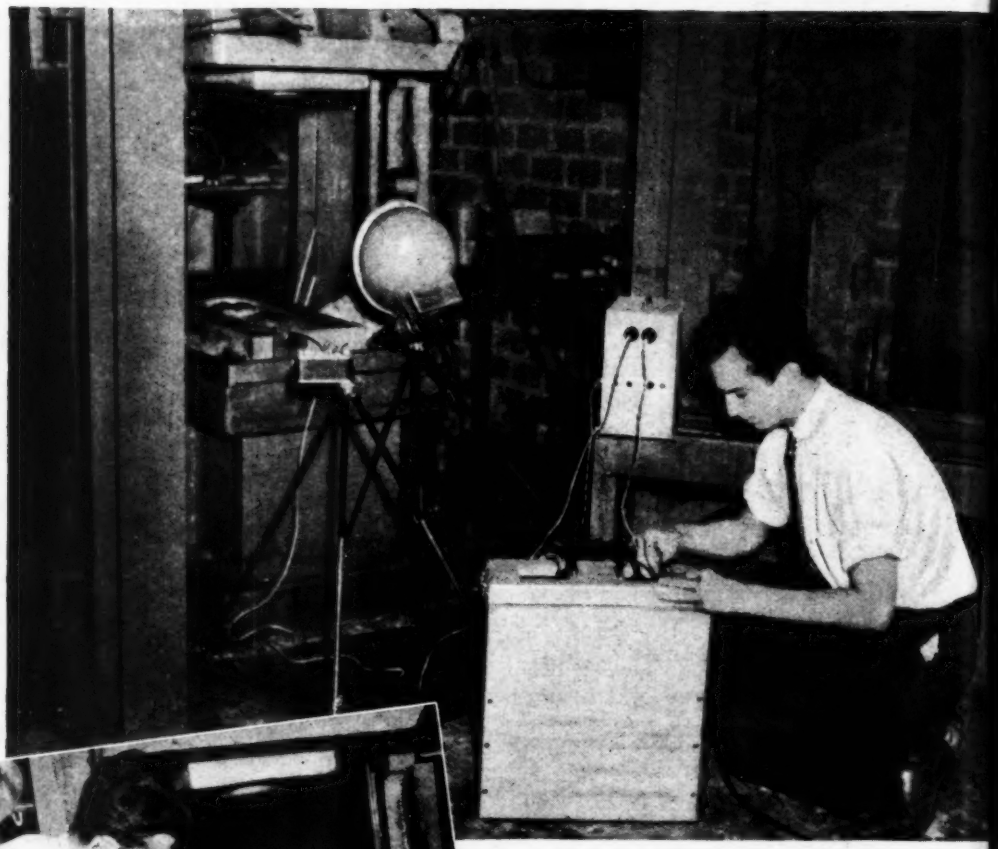

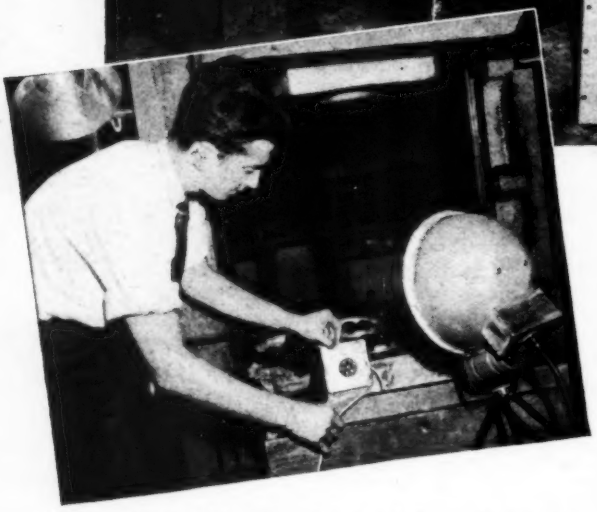

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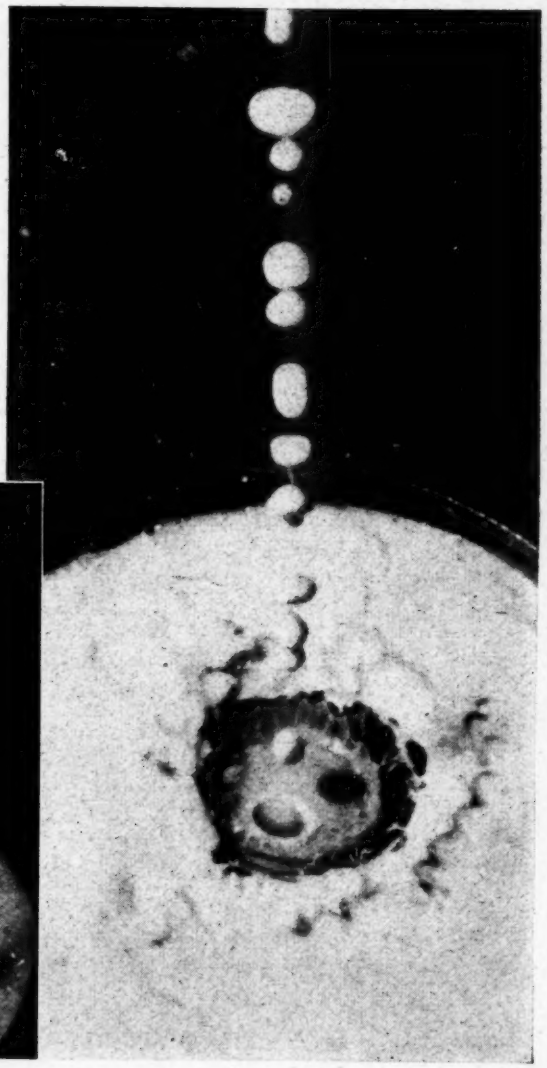

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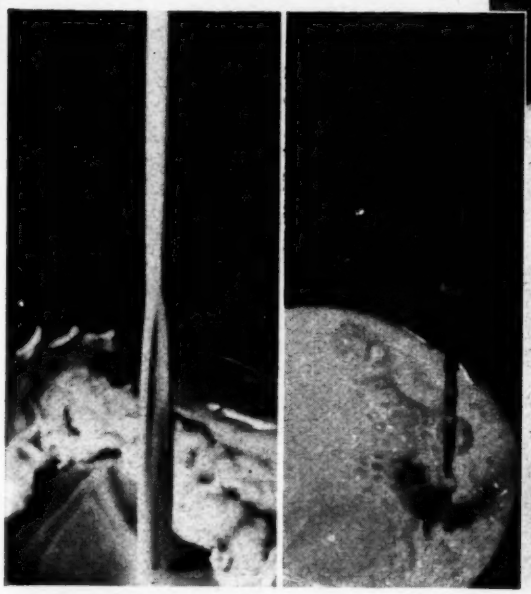

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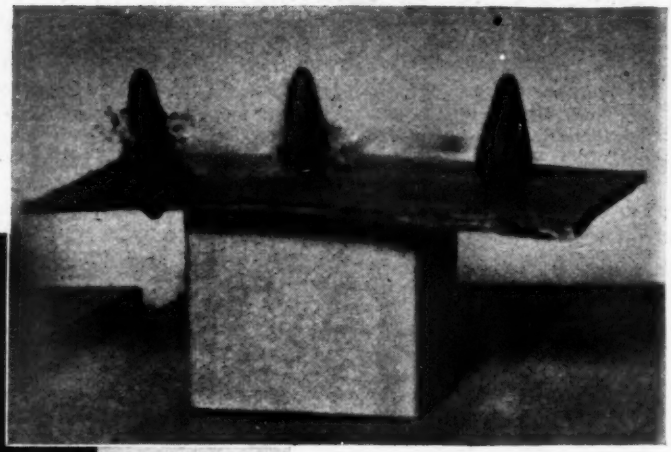

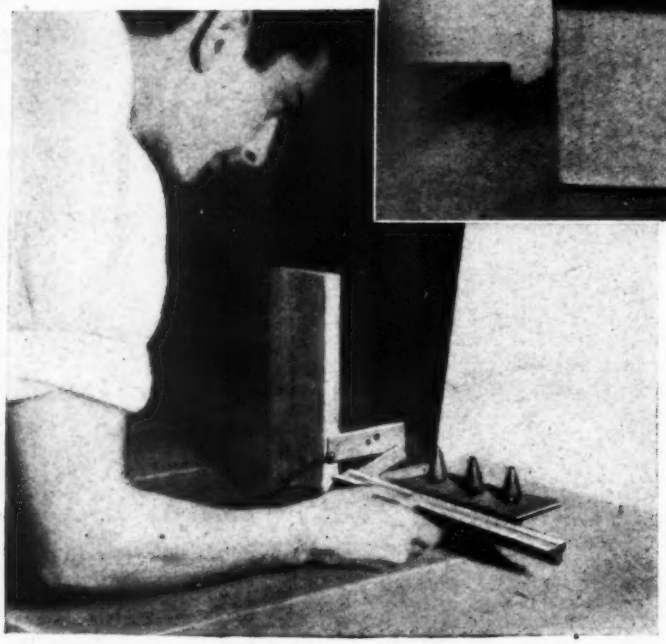

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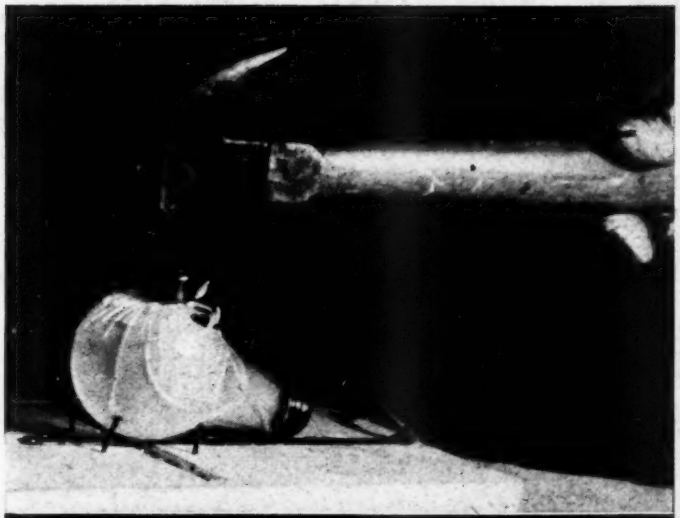

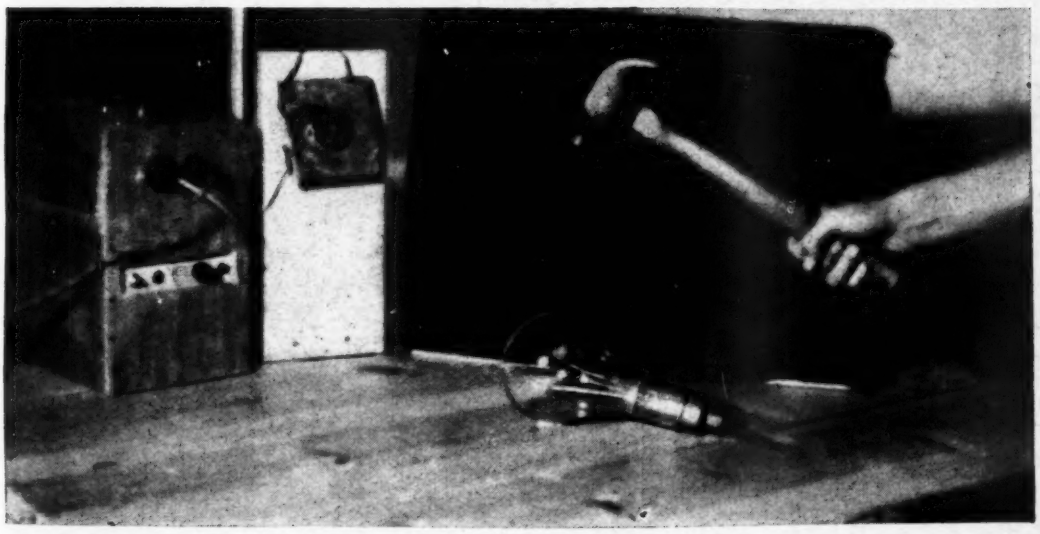

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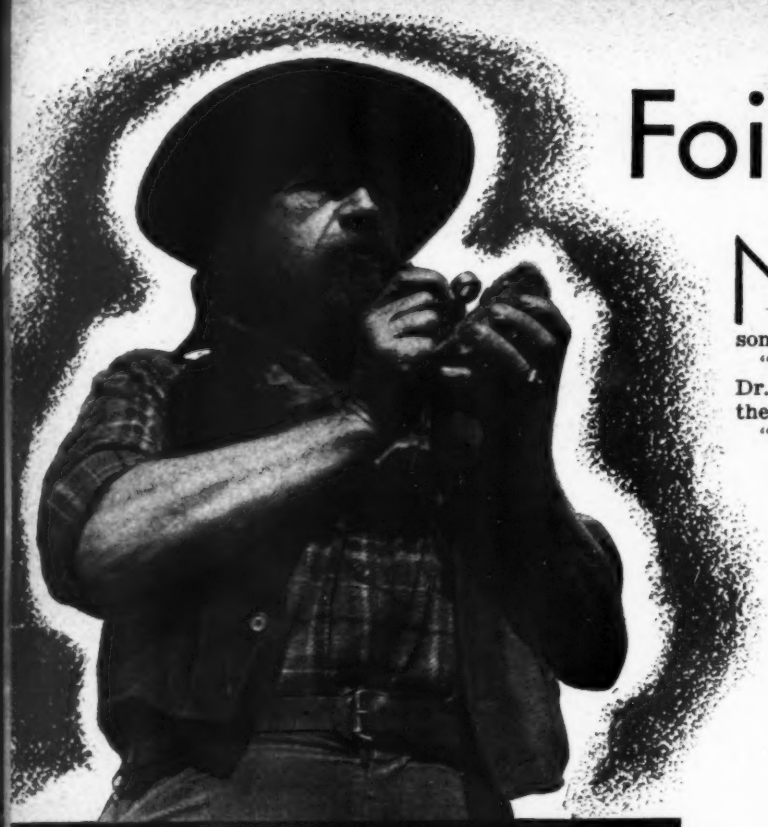


Foiling the

NOT long ago, a young mining engineer telephoned the office of Dr. John Herman, Los Angeles assayer, for reports on some gold-ore samples he had left.

"I'll read them to you," answered Dr. Herman. "Sample No. 1, $187 to the ton in gold; No. 2, $201; No. 3,—"

"Hold on," interrupted the engineer. "Something's wrong; those can't be my samples."

"They're what you brought in this morning," insisted Dr. Herman. "You'd better come over and we'll straighten this out."

When the two bent their heads over the report, the engineer grinned. "My client is just about to buy a mine," he explained, "but he wants my opinion before he pays any money. The fellows who own this claim are too smart to sell anything with ore this rich. I smell a rat!"

Together they went back into the laboratory and looked at

By
ROBERT E. MARTIN

GUARDING SAMPLES BEFORE ASSAYING
Bags of ore samples to be assayed are sealed and guarded carefully to prevent tampering. A common dodge of the mine salters is to jab a hypodermic needle into a sample bag and inject a solution of gold or silver, as illustrated at the right

Gold-Mine Swindlers

the "cuttings" of the original samples, the small quantity usually retained for check-up.

"Let's pan it and see what it looks like," proposed Assayer Harry Newitt, of the laboratory staff.

He got out a gold pan, dumped the sandlike material into the water, and rocked it back and forth. Soon little yellow glints appeared among the heavy sediment. Newitt gathered a tiny pinch and put it on a microscope slide.

"Look!" he exclaimed.

Through the eyepiece the engineer could see round, beadlike droplets of gold. Each was slightly flattened, as if dropped while molten. They looked fragile and some of them had shattered like eggshells.

"This stuff never came from the ground," grunted the engineer. "What d'you suppose it can be?"

Photographing an ore sample under ultra-violet light to study metal particles

"Let's spectro some of it and find out," suggested Dr. Herman.

A tiny pinch of the material, put into the cupped crater of the spectrographic arc, left a strong pattern of vertical bars upon the recording film. A little later, as the two stood in a projection room and looked at the image thrown upon the screen beside a master film showing all the metallic elements, the mystery was clarified.

"Gold telluride—no wonder that sample assayed high!" laughed Dr. Herman. "Some-

WILES OF THE MINE SALTERS

Gold dust mixed with clay and stuck under the finger nails makes ore "pan" well for a sucker. Another trick of the swindlers is to roll a little of the dust into a cigarette and allow the ashes to drop into the pan in which the sample is being washed

A veteran prospector reading his assay report in the office of Dr. John Herman

body's got hold of some roasted telluride-ore samples from a specimen cabinet and put them into the sample bags. That's just a little bit too good—it's like going fishing and catching a herring already kippered!"

Detectives of the gold fields are using new laboratory magic to expose mine "salters," those crafty promoters who load samples with gold to deceive unwary purchasers of claims. With camera, black light, and spectrograph, the assayer today may actually read clews in the tiny individual grains of gold. Minute scratches may show that they were filed off a watch case, or chemical tests reveal the presence of alloys used in dental gold. In the old days, the tricks of mine salting were practiced so extensively that they became well known, but since then a new crop of "suckers" has grown up. Today the old dodges are being extensively revived—but new scientific methods make it harder than ever to fool the expert. For, like other criminals, the mine salter usually leaves a telltale trail behind him.

A favorite scheme for salting is to load shotgun shells with gold and fire them against the face of a drift. The gold plasters itself against the rock realistically enough to fool most prospectors. But the microscope shows clearly how the droplets have splattered like raindrops on a windowpane, and the difference from natural gold is unmistakable.

"Salting the pan" is a more economical method — it doesn't take so much gold. Only 200 milligrams, rolled into a cigarette whose ashes are allowed to drop into the water while you are panning, will make a rich showing. One man appeared nervous while bending over to watch his prospect pan out a trial sample, but there was good reason why he kept running his hands through his hair—it was literally loaded with gold dust. Another mixed a little gold with clay and stuffed it under his finger nails—ten tiny samples that easily washed out as he panned trial batches of gravel in the presence of a possible victim.

Still another easy scheme is to dissolve the gold in aqua regia, a mixture of nitric and hydrochloric acids, and then squirt the solution over the rocks. Some of these are porous enough to soak it up, blotterlike. Many a novice, no matter how careful he was in tying up his canvas sample bags and protecting them with seals, has been fooled by a salter who jabbed a hypodermic needle through the canvas and added enough gold or silver-bearing solution to make the samples show bonanza values. Shovel handles have been bored and loaded with dust so it would dump out when the handle was turned the right way. Then there's the scheme of getting a sucker to take a sample out of each bucket that comes up from the mine—with a confederate below putting a few choice pieces of ore on top where they'll be handy. These methods still are in use today, but the modern assayer has new tricks in his bag.

"You might think that gold dust always looks the same," says Harry Newitt. "Well, it does, to the naked eye; but under a compound microscope there are noticeable differences. For example, not all gold is yellow. Some looks red, some white. On the beach at Nome, Alaska, it is nearly black.

"Placer, or stream-bed, gold has been well

THERE ARE MANY CLEVER WAYS OF "SALTING" A CLAIM BUT METALLURGICAL DETECTIVES CAN SPOT THEM ALL

sorted by nature, for running water has carried the smallest pieces farthest, dropping the heavier ones near the source. If panfuls from a given claim show several types of grains, it may indicate overlapping deposits drifted down from several 'mother' lodes upstream—or it may mean a salted claim.

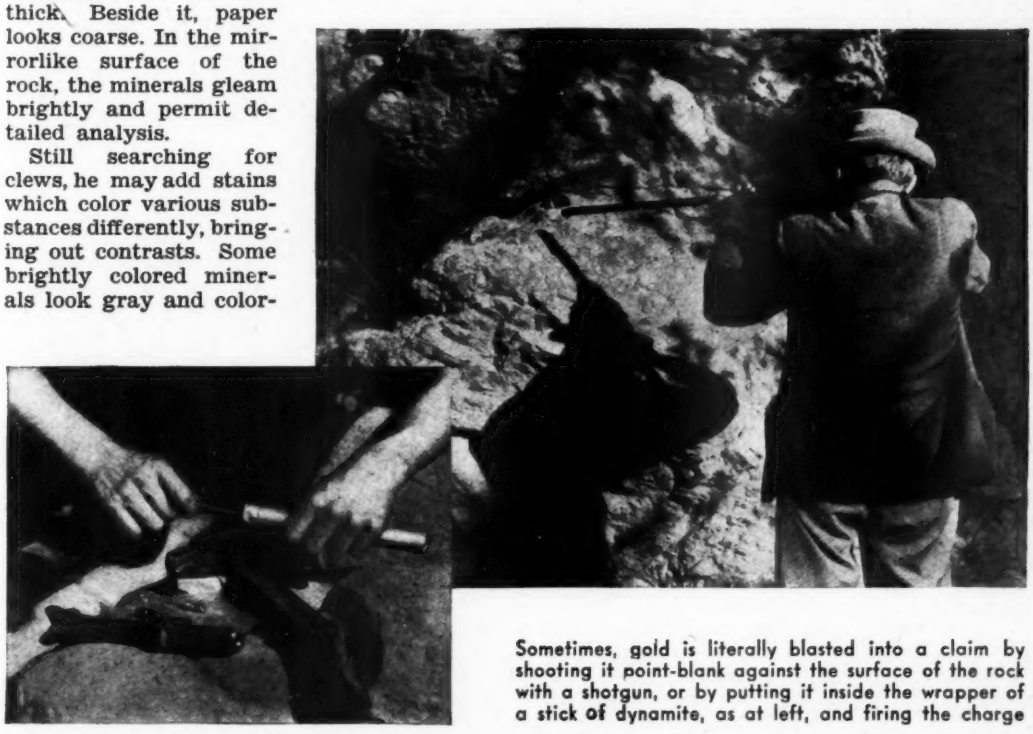
"Occasionally we have detected sharp grains of hard-rock quartz among samples from stream-bed, placer claims, or rounded, water-worn particles and even small nuggets in samples supposedly blasted from a hard-rock mine. When such a thing occurs, we know at once that the claim has been salted."

In half a dozen samples of ore from as many mines, you'll find that each piece has a different structure. In quartz, gold occurs in long narrow strings, in flat scales, tiny plates, or chunky masses. Sometimes it looks like clusters of crystals, whose pattern or grouping is a telltale characteristic. An assayer who suspects crooked work puts the specimen under a binocular, stereoscopic microscope. Like the old-fashioned parlor stereoscope, this instrument gives a three-dimensional view. Under oblique lighting, structural details stand out in strong relief.

For a better view, the assayer may prepare the specimen by slicing off one face of the rock with a lapidary's saw, gluing it to a chunk of sealing wax, then sawing off the other face and polishing it down until there remains only a wafer of rock about one two-thousandth of an inch thick. Beside it, paper looks coarse. In the mirrorlike surface of the rock, the minerals gleam brightly and permit detailed analysis.

Still searching for clews, he may add stains which color various substances differently, bringing out contrasts. Some brightly colored minerals look gray and colorless under perpendicular reflected light. Or, using special prisms, he can examine a specimen with two beams of light of different velocity, thus determining the refractive index. He may even photograph the sample under ultra-violet light, then run a small calibrated wheel around the splotches of mineral to measure their area and get the typical size of the gold particles. Often this method is used to determine whether an ore can be milled efficiently, or whether the cyanide or

Hundreds of small pans in the assayer's laboratory hold samples of assayed ore for future check-ups



Sometimes, gold is literally blasted into a claim by shooting it point-blank against the surface of the rock with a shotgun, or by putting it inside the wrapper of a stick of dynamite, as at left, and firing the charge

flotation process should be applied instead.

If the sample consists of gold dust, he may mix it with a plastic material and vulcanize it into an artificial rock, to be examined under the petrographic microscope with polarized light. He may count the particles in a known weight of sample, estimate their size, note their shape, and look for telltale signs of adulteration. And if these methods fail to reveal fraud, chemical and spectrographic tests may yield a clew.

Natural gold varies considerably in purity. Alaskan gold, for instance, runs about 900 fine (900 parts gold in each 1,000); but in some regions the fineness drops as low as 500. In places it is found as "electrum," a natural alloy half gold, half silver. The purest gold ever discovered ran 99.7 to 99.8 percent pure, the minute remainder consisting of copper, a little iron, and an infinitesimal trace of silver. Even such small impurities would register clearly on the spectrograph, and any gold that didn't conform to this "recipe" could easily be detected.

One day, a promoter walked into Dr. Herman's Los Angeles assay laboratory with a sucker in tow, proudly bringing a sample for test. When the pair returned and opened the report, the first man snorted indignantly.

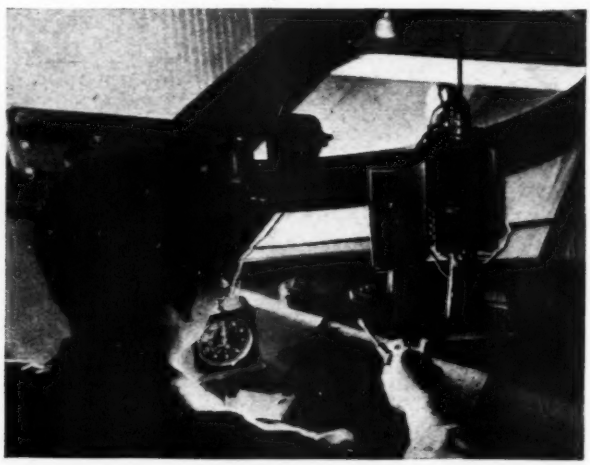
"Dollar and a half to the ton! Why, man, you're crazy. That mine's a bonanza. What kind of an assay do you call this?"

The assayer smiled. "If you're not satisfied, we'll run it again for you."

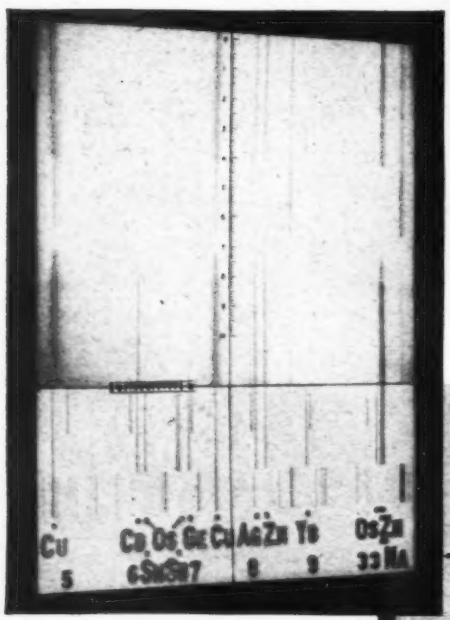
The two left in a huff, but soon the promoter returned—alone. "Say," he asked confidentially, "what's the matter with you fellows? That sample had plenty of gold in it. I know—because I put it in!"

"Where did you get the gold?"

"At the dime-store jewelry counter," was the startling response. Of course, the jewelry had contained no gold at all.



This is the spectrograph. The open chamber contains a carbon arc in the cavity of which a sample of ore is placed

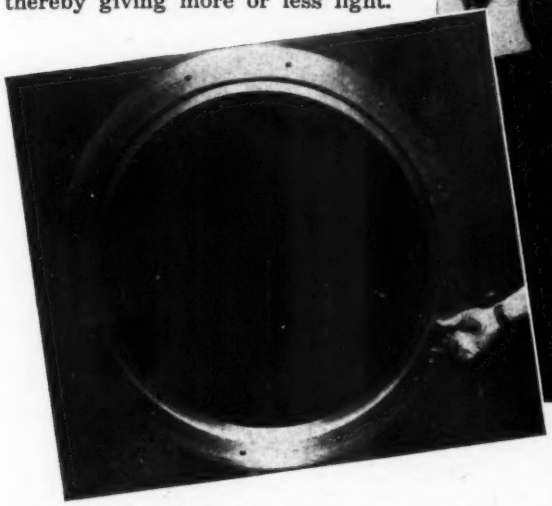


A TYPICAL SPECTROGRAM

Projected on a screen as seen at the right, this pattern of vertical bars shows what metals the sample contains. The upper set of bars is from the film made of the sample, while the lower set is from a master spectrogram film showing all the metallic elements for comparison

Novel Train Windows Give Light Control

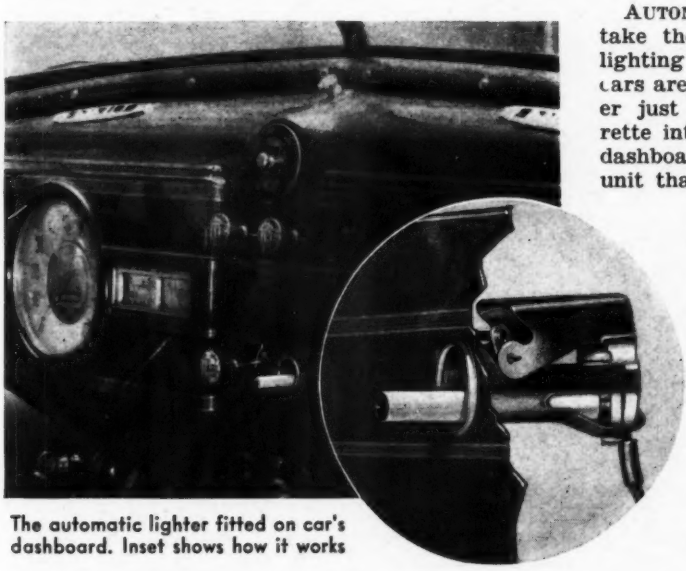
SHADES are not necessary on the light-conditioned windows recently installed in the observation car of a crack Union Pacific streamline train. Circular in shape, each window has three panes, the outside pane of plate glass, and the two inside panes of a light-polarizing material (P.S.M., April '36, p. 20). The innermost pane can be rotated by a knob to change the relation of its optical axis to that of the second polarizing pane, thereby giving more or less light.



Glare-free polarized light from out of doors is regulated in this special observation car by a twist of the window knob, as at the left

Dashboard Cigarette Lighter Works Automatically

AUTOMOBILE drivers do not have to take their eyes from the road while lighting a cigar or cigarette when their cars are fitted with an automatic lighter just announced. Inserting a cigarette into a cylindrical tube set in the dashboard actuates an electric heater unit that lights the cigarette.



The automatic lighter fitted on car's dashboard. Inset shows how it works

Scout Plane Rides on Bomber's Back

BOMBING planes that carry tiny, powerful combat planes after the manner of the British pickaback commercial plane recently tested, have been suggested as a military development of the twin-plane principle. The fighter escort would be released to protect the bomber from overhead attack.

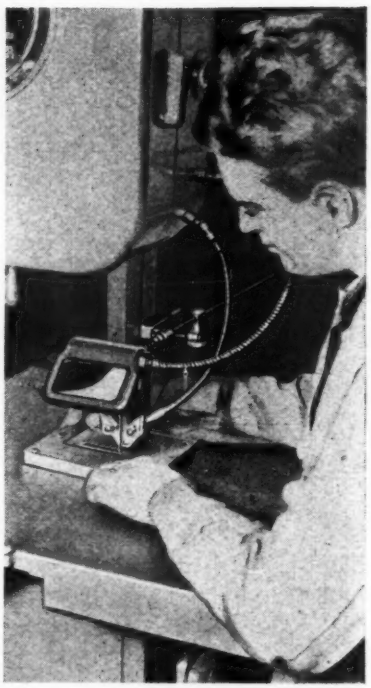
Jerry, the lineman's pup, helping his master wire a power pole

Pole-Climbing Pup Helps Lineman

SCRAMBLING up extension ladders is all in the day's work for Jerry, a climbing canine who always accompanies his master, a Miami, Fla., electrician, wherever his work takes him. In the photograph at the left, the dog is shown perched on the cross arm of a power-line pole which his owner is preparing to wire. Unfortunately, the pup is not acrobatic enough to scamper down ladders, and must depend on his master to take care of al descents.

Illuminated Lens Fits Power Tools

FINE work with home-workshop power machines is made easier with the aid of a combination magnifying glass and electric bulb that enlarges and illuminates the operator's view of his work. The unit clamps to the machine's guide post, as shown below.

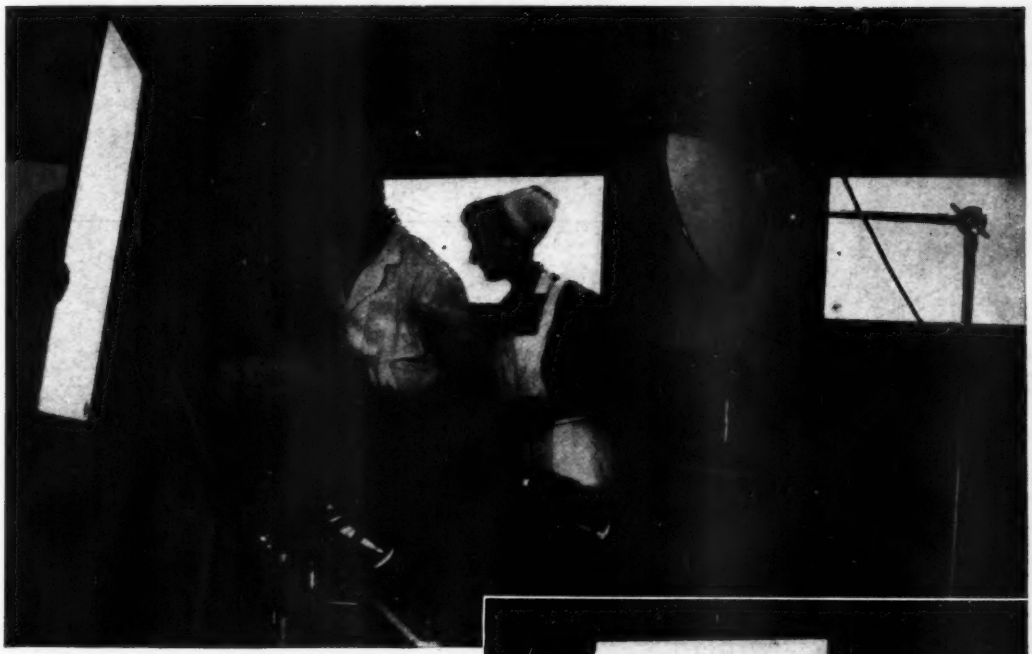


Combined magnifying glass and lamp as mounted for use with a band saw

Ink-Bottle Stopper Fills Pens

Pen is inserted in the rubber sleeve and the bottle turned up

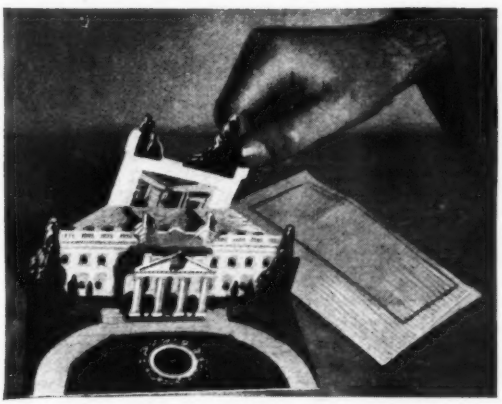
SERVING both as a filling device and a cork, a handy ink-bottle attachment simplifies filling a fountain pen. Consisting of a flexible rubber sleeve, the unit fits snugly into the neck of an ink bottle. The fountain pen is inserted into this sleeve, which stretches to accommodate it and insure a leakproof fit. The bottle is then turned upside down and the pen filled with no danger of spilling ink or getting it on the fingers. Between fillings, a rubber stopper is inserted in the sleeve to make it serve as a cork.



A desk lighted by a luminous screen. In the upper photo, the same system is applied to a hospital operating room

Luminous Screens Provide Emergency Air-Raid Light

TO SAFEGUARD vital spots such as hospital operating rooms, power-plant switchboards, telephone central offices, and crowded bombproof cellars in case of the failure of electric current during a wartime air raid, ingenious light screens are now being tried out in Germany. Made of cloth or paper, the screens are coated with a luminous paint which absorbs light during the daytime or when lamps are on, and then radiates it in the darkness. Photographs show two applications of the novel lighting method.



Three-dimensional post-card view of the White House

Set-Up Scenic Post Cards

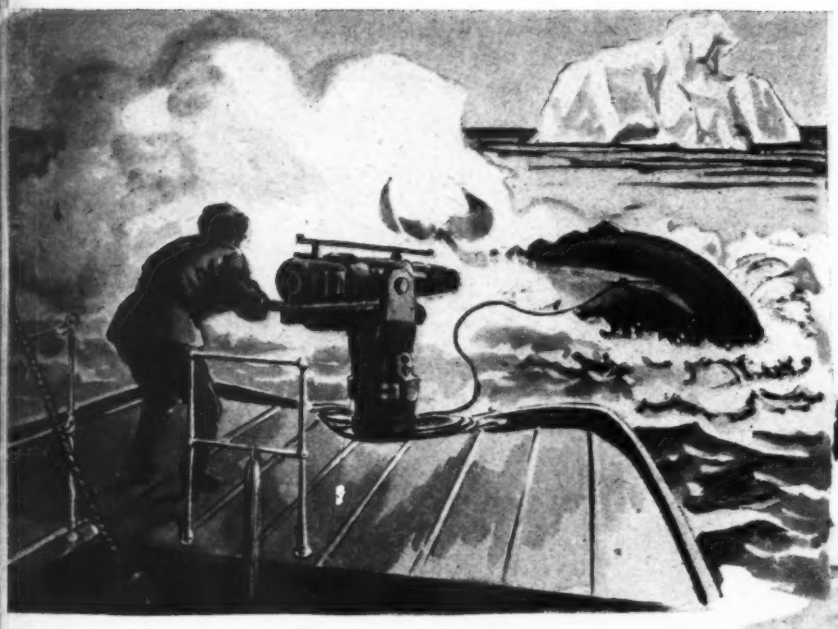
THREE-DIMENSIONAL picture post cards that fold flat for mailing are now available to tourists. Representing famous buildings and monuments, they can be raised into an upright position like the fancy valentines supplied to children. At the left, one of the novel post cards is being set up.

Detects Carbon Monoxide

DANGEROUS amounts of carbon monoxide in the air are detected by a homemade device recently invented. A bicycle pump forces air through the apparatus, and the concentration of the gas is shown by the number of strokes required to color a chemical reagent.

Floating Factory

FAST "KILLER" BOATS, BRING GREAT CHANGES



A harpoon gun being fired at a whale from one of the "killer boats" that serve the floating whale-oil factory pictured below. Drawing at the lower right shows how the deadly explosive harpoon works

Drawing by B. G. SEIELSTAD

LOOKOUT
FAST "KILLER" BOATS HUNT AND KILL WHALES
HARPOON GUN
2 SKILLED WHALEMEN CALLED FLENSERS CUT AWAY SURFACE LAYER OF BLUBBER
W
W
WINCH
1 WHALE IS HAULED ABOARD THROUGH TUNNEL AT STERN
4 STEAM PRESSURE COOKERS EXTRACT WHALE OIL FROM BLUBBER
6 WHALE OIL IS STORED IN TANKS BELOW DECKS
DOUBLE BOTTOM HOLDS FUEL OIL
CLAW RESEMBLES HUGE ICE TONGS
WHALE IS PUMPED UP WITH COMPRESSED AIR TO KEEP IT AFLOAT
FLAG AND ELECTRIC BLINKER IDENTIFY OWNE AND HELP FACTORY SHI TO FIND WHALE

Aids Modern Whalers

FIRING DEADLY NEW EXPLOSIVE HARPOONS,

TO THIS TRADITIONAL AMERICAN INDUSTRY

7 REMAINING CARCASS IS CUT UP ON THIS DECK
WINCHES
WINCHES
HYDRAULIC SAWS CUT BONES
5 SEPARATORS IN DECK HOUSE REMOVE WATER FROM WHALE OIL
8 GRINDER PULVERIZES BONES FOR USE WITH OTHER REMNANTS AS FERTILIZER
3 BLUBBER IS FED TO COOKERS THROUGH HOLES IN DECK
AUXILIARY TANKS CARRY EXTRA FUEL FOR LONG VOYAGES, WHICH IS USED FIRST, AND TANKS ARE THEN CLEANED FOR STORING WHALE OIL

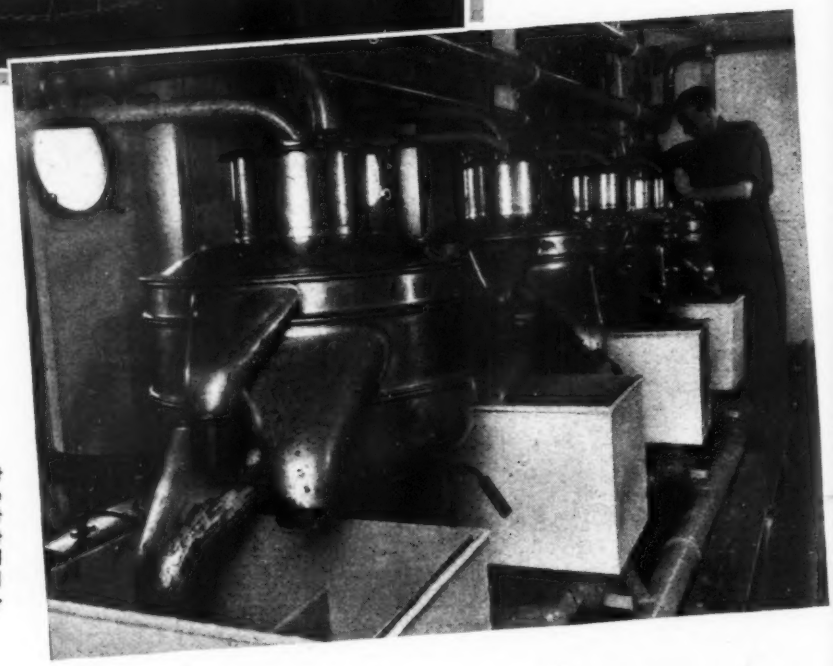
BOMB SERVES AS POINT FOR HARPOON
WHEN BARBS OPEN, BOMB IS EXPLODED, KILLING WHALE
LASHINGS ON BARBS SLIP OFF OR BREAK WHEN HARPOON STRIKES WHALE

AT THE bottom of the world, down in the antarctic, the three-month whaling season is just beginning. From now until next March, thirty-two expeditions will hunt the greatest monsters of the deep. Among the most modernly equipped will be a fleet that flies the Stars and Stripes—the 10,000-ton "factory ship" *Ulysses* and its convoy of ten fast 140-foot "killer" boats.

In recent years, British and Norwegian ships have held a virtually undisputed monopoly of the whaling industry, supplying millions of dollars' worth of whale oil to soap manufacturers and others who use it. Gone from the sea were the adventurous American whalers that once put out by the hundreds from centers like Nantucket and New Bedford, Mass. Then, last year, began a revival of large-scale whaling by Americans.

In April 1938 the *Ulysses,* converted from a tanker into a giant floating whale-oil factory, returned from its maiden voyage to the southern whaling grounds. It bore 9,000 tons of whale oil, valued at $1,000,000. Fighting storms worse than tropical hurricanes, and often working in half darkness, the modern inheritors of the American whaling tradition captured more than 4,000 whales. Their prize kill, a blue whale ninety-

Through this inclined tunnel at the stern, whales killed by the smaller vessels are dragged up onto the deck of the "Ulysses" where the blubber is cut away for cooking

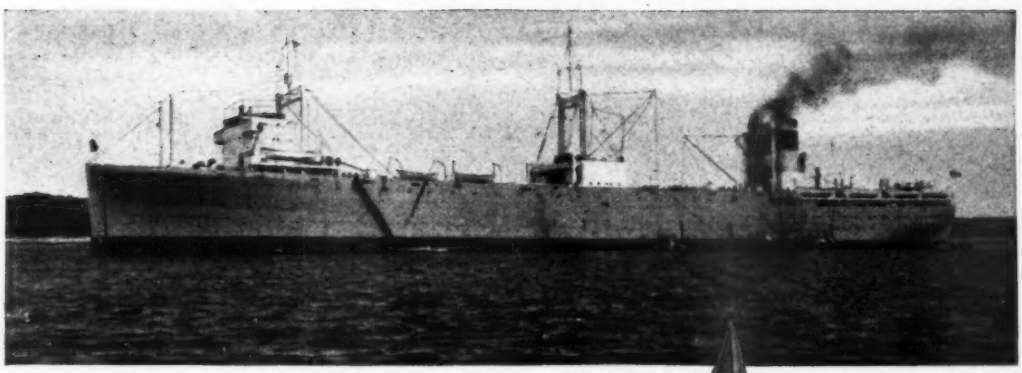


Operating like giant cream separators, the machines at the right remove the water that is mixed with the oil when it is extracted from the whale blubber

six feet long and weighing 192 tons, was the record catch of the season in the Weddell Sea. Encouraged by these successes, the owners of the *Ulysses* and its auxiliary fleet have planned a larger expedition for the present season, with 400 men.

Whaling has changed vastly since the era of the New England whalers. In those days, killing a whale meant a perilous close-range combat with harpoons and lances, in a whaleboat propelled by oars or sails. Then the invention of the harpoon gun, with its explosive projectile, made the "kill" quicker and safer. Finally, the third and modern era of whaling has brought "factory ships" like the *Ulysses*—large-scale blubber-treating plants afloat, served by a whole fleet of speedy "killer ships."

The ten 140-foot boats that follow the *Ulysses* do the actual hunting. From bow guns, they fire 200-



Flagship of an American whaling fleet—the factory ship "Ulysses"

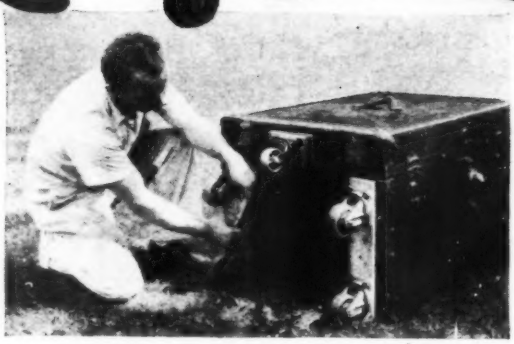
pound harpoons that explode three seconds after hitting a whale, instantly killing it. Then the huge body is pumped up with compressed air to keep it from sinking, and marked with a flag and a blinking light to help the *Ulysses* find it. The factory ship hauls the carcass aboard through an enormous inclined runway in the stern, the blubber is then "tried" or cooked, and the resulting oil is stored in the ship's giant hull tanks.

Below are some tools of the modern whaler: blubber knives, blinker light for marking the carcass, and compressed-air hose for blowing it up. Right, a 200-pound explosive harpoon

Workshop In Trunk Aids Magician

Ralph Doremus, assistant to Blackstone the magician, at his odd traveling workbench

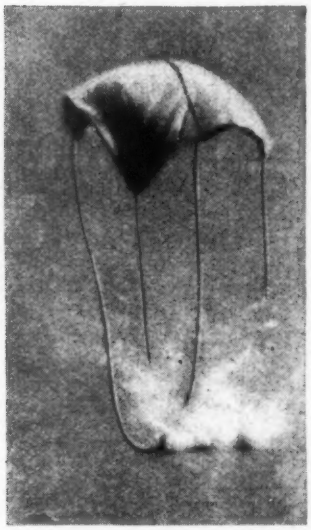
All tools needed to service the magician's stage equipment can be stored in the medium-size trunk



Four rubber-tired casters attached to one end of the trunk, and a fifth on the same end of the lid, make the chest literally a workshop on wheels to simplify moving

SERVICING and repairing the secret mechanism that causes a live horse to vanish into thin air is one of the odd tasks assigned to Ralph Doremus, stage manager for Blackstone, the famous American magician. For this and other curious jobs, Doremus devised the self-contained, portable tool chest shown in the photographs on this page. Mounted on substantial casters that allow it to be rolled easily around a stage, the chest, constructed from an old wardrobe trunk, provides a place for a soldering iron, saws of various types and sizes, a vise, a complete set of carpenter's tools, a motor-driven compressor, a paint-spray gun, a shaded lamp to illuminate the work at hand, and other miscellaneous equipment. An electric extension cable makes it easy to tap local electric supply lines, and outlet receptacles are provided for plugging in the chest's electric power tools. Not the least important of the chest's features is a built-in fan to keep the touring repairman cool during the hot summer months. In its travels from theater to theater during the past year, the compact unit has been examined and admired by hundreds of lovers of magic, many of whom were home-workshop fans who subsequently made duplicates of the chest with minor changes in their interior arrangements, to adapt them for their own uses.

Left, a can of fish being dropped from a plane. Below, slowed by a parachute, the fish land safely



Plane Drops Fish To Stock Lake

PACKED in tin cans attached to diminutive parachutes, thousands of young fish were recently dumped from a speeding seaplane into the waters of Lake Washington by Washington State game officials to see whether they would survive the shock of their 1,000-foot drop into the water. The first experiment of its kind in the United States, it proved that remote mountain lakes could be successfully stocked with fish by airplanes. Results demonstrated that the fish were not harmed by the unusual method of stocking.

Spring Holds Ties on Handy Rack

TIES hung over a compact new tie rack that fits flat against a wall or a closet door are held firmly in place. When a lever on the rack is pressed, the rod springs away from the wall and the ties are then easily removed by pulling, as illustrated in the photograph above.

Meter Tells When Walls Are Dry

DISCOLORATION and blistering, caused by painting or papering over walls that are not absolutely dry, can be largely eliminated, according to the makers of a moisture meter recently placed on the market. Operating on an electrical-resistance principle and powered by a self-contained battery, the meter registers the moisture content of newly applied plaster, thereby indicating whether the wall is dry enough for the application of paint or wall paper. In use, a testing unit, connected to the case containing the meter dial by a flexible cord, is held against the wall surface.

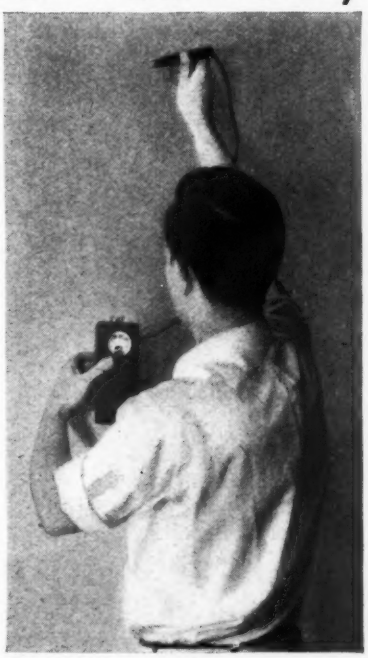
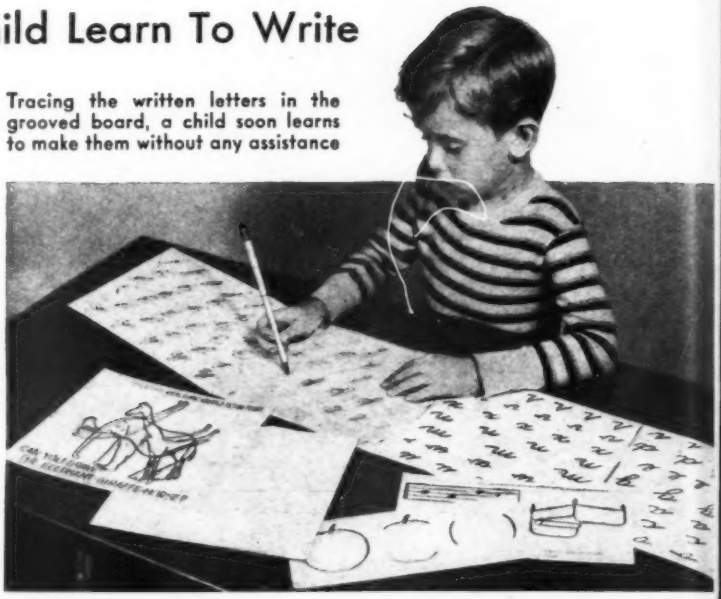


Chart Helps Child Learn To Write

CHILDREN are now being taught how to write the letters of the alphabet in script by means of novel charts recently invented. The charts consist of folders of heavy cardboard in which are grooved script letters. A child places a sheet of transparent paper over the chart and traces with a blunt pencil the indented chart letters until he becomes familiar with their form. In smooth spaces between the grooved letters, he also can try drawing them free-hand, without the artificial aid.



Tracing the written letters in the grooved board, a child soon learns to make them without any assistance

Cut to fit the nose, the pads relieve eye weariness

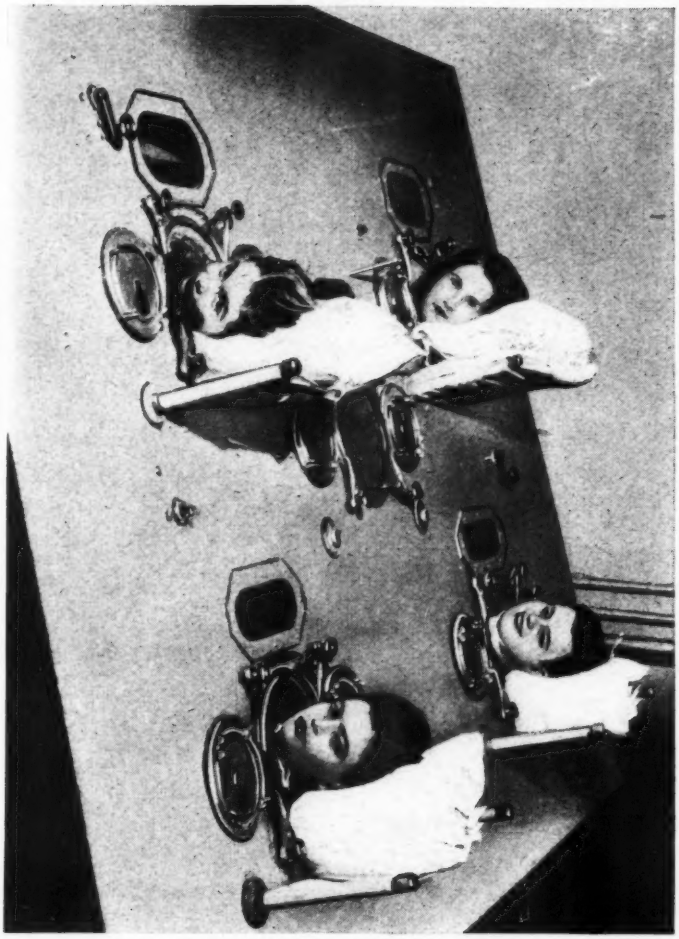
Pads Relieve Eye Fatigue and Aid Complexion

EYE PADS that are said to have a refreshing effect on tired eyes are now available as a new aid to beauty. Made of featherweight felt, the eye masks are impregnated with a special solution. As shown in the photograph at the left, the user tilts the head back, presses the pads gently over the eyes, and then leaves them on for a period of about five minutes. Stimulating the circulation of the blood in areas around the eyes, the pads are said to relieve discolorations.

The gunner sits in a special rest to adjust the sights of this new machine gun

New Air-Defense Gun Gets Test

REMARKABLE accuracy is claimed for a new rapid-fire gun which was given its first official trial recently by U. S. Army officers at Fort Bragg, N. C. Developed especially for antiaircraft use, the .50 caliber defense arm is operated by a gunner who steadies himself in a novel rest pictured at the left as he regulates the weapon's delicate aiming mechanism. The new weapon is designed for use against low-flying planes.



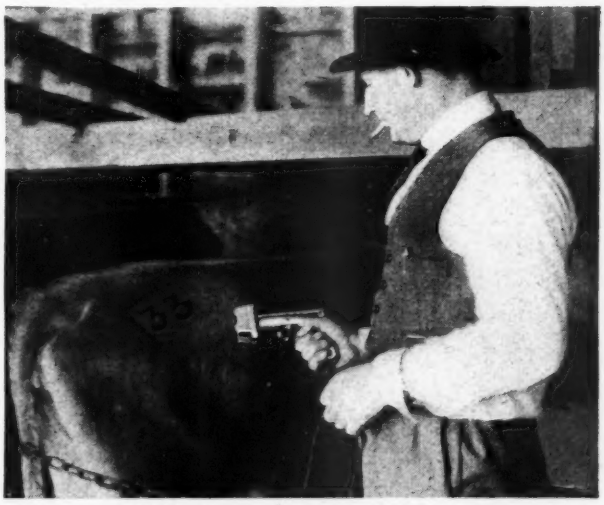
Patients can keep one another company in this four-passenger iron lung

Giant Iron Lung Gives Treatment to Four at Once

FOUR persons may be treated at the same time in a novel multiple iron lung recently placed in service at the Children's Hospital, Boston, Mass. It is explained that the medical profession is not invading the field of mass production, but rather that research studies have indicated that a single pressure and breathing rate may be used for a number of patients afflicted with respiratory ailments that require the use of a mechanical aid to breathing. Since four separate units would take up too much space and complicate hospital routine in handling such cases, the two-decker shown in the photograph at the left was constructed. Other advantages claimed for the device include a reduced expenditure for operation, compared with the cost of running four separate machines, and also the fact that each patient has company and can carry on conversations with others.

Electric Branding Gun Replaces Heated Iron

CATTLE are marked quickly, easily, and humanely with a novel electric branding gun invented in New Zealand. Powered by a six-volt car battery when regular current is not available, the branding device is said to require only five seconds to heat up to branding temperature. Detachable letters or numerals are inserted in the end of the unit's pistol-shaped body, the trigger is tripped to start the electric heating unit, and the brand is pressed against the flank of the animal. A special searing iron can be attached to the branding gun for use in docking the tails of lambs, saving much time on a large sheep ranch.

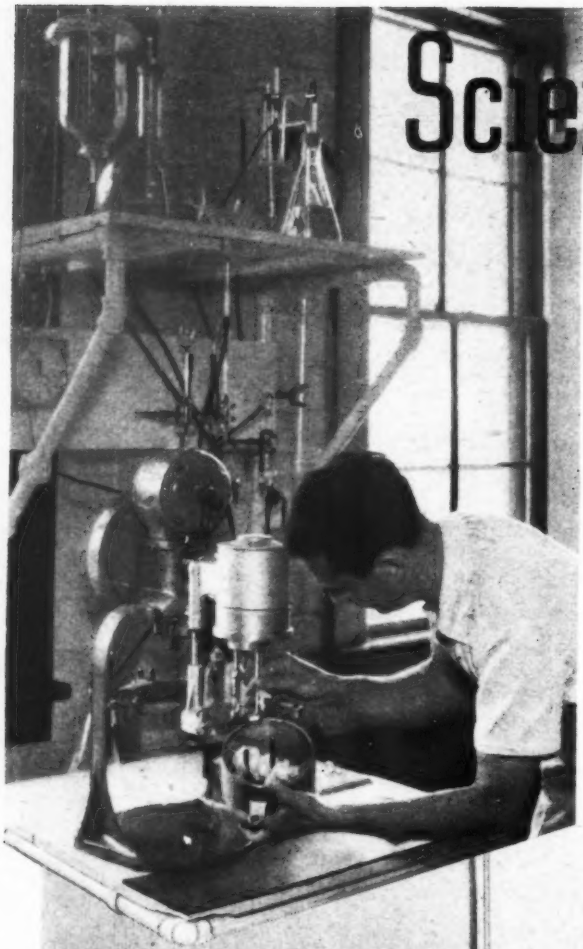


When the trigger is pulled, electric current heats the brand

Science Builds

WORKING on a doll-house scale, in air-conditioned laboratories at Wooster, Ohio, Government scientists bake bread that is never to be eaten and cakes that will never be tasted. Their task is to test samples of experimental wheat from seventeen different states, to determine whether a new variety is suitable for bread, crackers, pastry, or cookies. If so, it soon may find its way to market and your table.

After the experimenters have measured the amount of protein and moisture in samples of wheat, a rotary electric oven bakes eighteen midget loaves at a time—each one about one fourth the size and weight of the kind you buy at the store. Placed on a



Dough from samples of experimental wheat is mixed in this special machine to make bread at the cereal chemistry laboratory, Wooster, Ohio

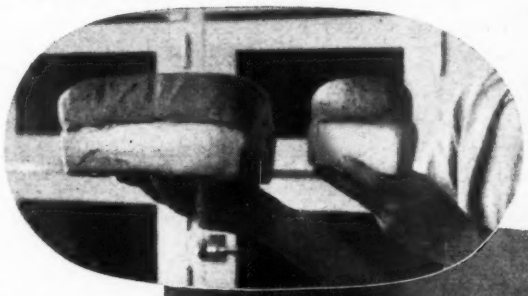
Miniature flour mills grind the grain in a room which is carefully controlled for temperature and humidity

A Doll-House Bakery

By JAMES L. BURDEN

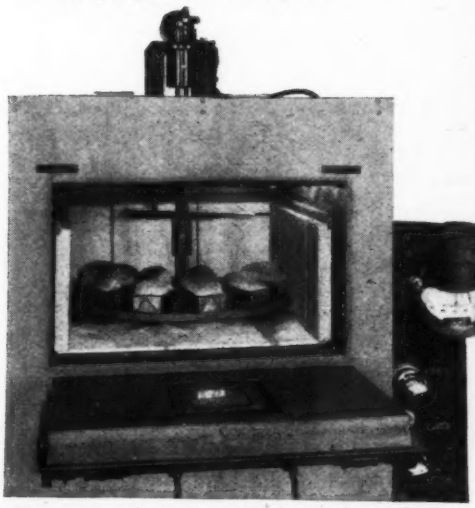
"scoring shelf," they are judged on such points as color, thickness of cell walls, shape of cells, and number of extra-large holes.

Even the growing of wheat for the loaves is done in miniature. Each row, one rod long, yields a bundle of wheat that may be held in one hand. The threshing machine is a tiny homemade device. Small labeled paper sacks hold the wheat, and care is taken to avoid mixing the wheat from one row with that from another, so that each individual strain can be judged on its merits.

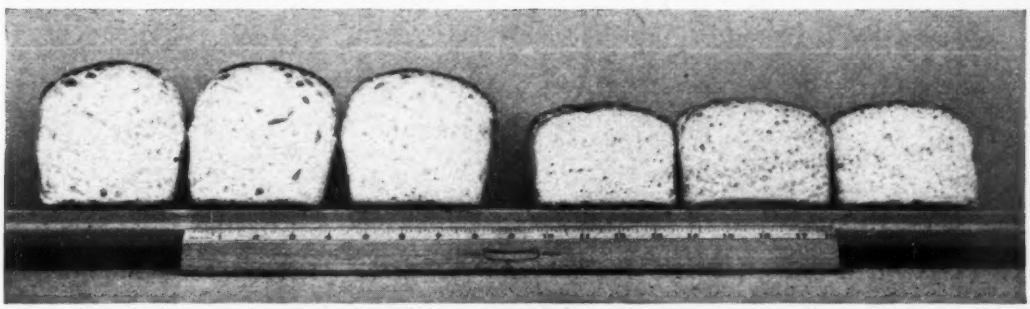


Bread that nobody will eat. These are "pup" loaves, one fourth the size of the standard loaf. They show whether the wheat tested makes good bread

Practical bread-making tests are supplemented by chemical analysis to reveal the amounts of protein and moisture the wheat contains. This photograph shows the rows of flasks in which samples of wheat are placed



This rotary electric oven bakes eighteen loaves at a time, at a temperature of 450 degrees F.

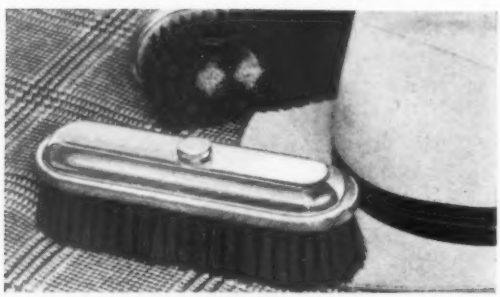


Pygmy loaves on the scoring shelf where they are judged for color, thickness of walls, and other qualities

Scientist Smokes Liquid-Air Cigar As Novel Stunt

ALTHOUGH at first glance the photograph at the right may seem to show the victim of a practical joke, with a glass of beer near one hand and an exploding cigar in his mouth, it actually depicts Dr. Francis Smith of the National Bureau of Standards, Washington, D. C., demonstrating what happens when a cigar which he has dipped into a glass of liquid air is lighted. Saturated with excess oxygen, the cigar tip flares out like a Roman candle with a brilliant flame five inches long.

Dipped in liquid air and then lit, the cigar flares up like a Roman candle



Note tufts that feed cleaner through the bristles

Spot-Removing Brush Has Cleaning Fluid in Handle

SPOTS and stains on hats, coats, and other wearing apparel are removed by a novel double-duty clothes brush now available. A reservoir in the handle of the brush is filled with gasoline, benzine, naphtha, or other cleaning fluid which filters down through special tufts and is applied directly to the material being brushed. The use of special bristles is said to give the brush a long life.

Pressing a button on the handle of the oil can lights the built-in lamp

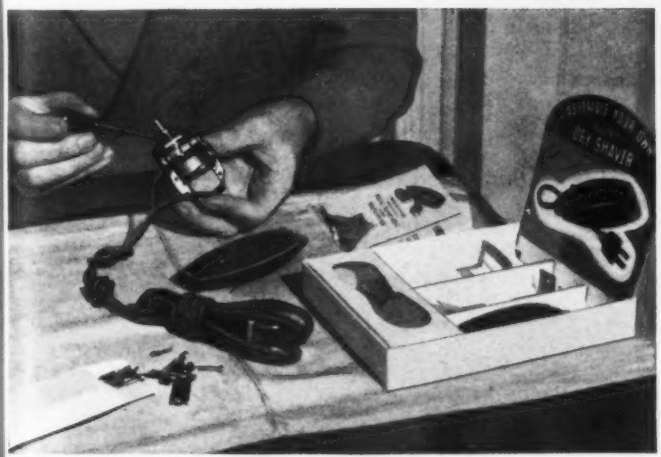
Garage Oil Can Gets Headlight

DESIGNED by an English inventor for use by garage and service-station attendants, an oil can for filling automobile crankcases has a built-in flash-light bulb and battery. Especially useful at night, the oil-can headlight throws a bright beam on the filler tube as oil is being poured from the can, to prevent spilling. In the photograph at the left, a garage mechanic is demonstrating the oil-can headlight to a customer.

Rubber Trolley-Wire Guard Protects Miners

TO PROTECT miners from accidental contact with the overhead high-voltage trolley wires used to supply power to electric locomotives, a new type of rubber guard has just been perfected. Thin sheet rubber, folded double and cured in a permanent U shape, is hung over the bare wire, with notches cut to accommodate the trolley-wire supports. The trolley feeder pole slips easily through the guard, which flexes in either direction if accidentally hit by a workman or by one of his tools.

There's no danger of shock here. Right, how the mine-trolley guard is installed

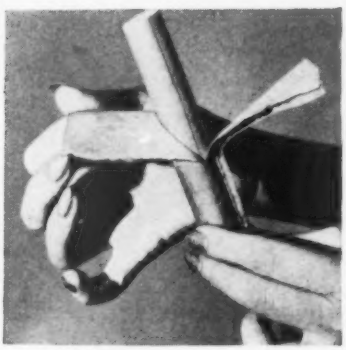


Kit Holds Electric-Razor Parts

MECHANICALLY minded men who want an electric razor can assemble their own by purchasing an inexpensive kit now available. Conveniently packed in a cardboard box with full instructions, the unit includes a self-sharpening shaving element that is durable and efficient, and a 110-volt A.C.-D.C. motor fitted with heavy, silver-tipped brushes made of phosphor bronze. The dry shaver is said to be extremely easy to assemble with simple tools. The photograph reproduced above shows various parts of the kit being assembled into a complete electric razor.

"Hot Dogs" Peel Like Bananas

MADE so that they can be peeled like bananas, "hot dogs" with removable skins were displayed recently at a Milwaukee, Wis., butchers' convention. The outside skin in which the Frankfurter is cooked has perforations on opposite sides so that the jacket can be stripped off before the Frankfurter is eaten, as shown in the photograph below.



Machine Types, Sets Type, in One Operation

TYPEWRITING and typesetting are accomplished in one and the same operation by an ingenious machine devised for use by business houses which do their own printing. No skilled typesetter is necessary. When a typist, operating the standard typewriter keyboard, strikes the keys, the letters are not only printed on paper but are also set in type, as individual type characters slide down from a sloping rack to their place in a type form.

Type characters drop into place when the typewriter keyboard is operated

Carvings Cure Homesickness

CARVING scenes depicting life on the farm back east is a sure cure for homesickness, according to "Tennessee Joe" Snavely, a decorator, or set dresser, employed by various motion-picture studios in Hollywood, Calif. Since he moved to California sixteen years ago, Snavely has been keeping alive the memories of his old home in the Tennessee hills by making intricate, landscaped carvings of typical farm scenes. Snavely is pictured beside a sample of his work in the photograph reproduced above.

Elastic Watch Strap Fits Any Size Wrist

IT IS not necessary to unfasten a novel watch strap now available before putting it on or taking it off the wrist. Made of leather, the strap has a metal-chain insert that expands to allow the strap to be slipped over the hand, and automatically adjusts it to the size of the wearer's wrist. The illustrations below show how the watch is put on, and how the chain insert expands.

A flexible link section replaces the usual buckle on this new wrist-watch strap

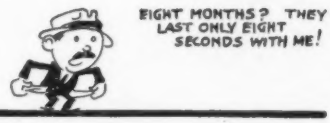
The Man with the Net

CUBA *is the home of the world's smallest frog. It weighs hardly more than three grains of wheat.*

HOLLYWOOD *movies cost an average of $2,500 an hour to film.*

WHALES *of one species are only four feet long when they are full-grown.*

EIGHT *months is the average life of a dollar bill.*



GOLF BALLS, *when driven from the tee, remain in contact with the head of the club about one five-thousandth of a second.*

SLIME MOLD *has been studied for 200 years, yet scientists are unable to agree whether it is a plant or an animal.*

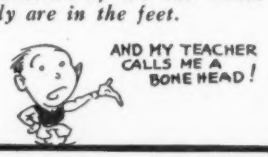
300,000 *tons is the estimated weight of an average cloud.*

HONEYBEE *races, run like homing-pigeon contests, have been held in New Jersey.*

TWENTY-SEVEN *communities in the United States are named Cleveland; twenty-eight, Troy.*

EVERYBODY *in the world could have half a million dollars' worth of gold if all this precious metal contained in sea water could be extracted.*

ONE QUARTER *of all the bones in a child's body are in the feet.*



Beauty-Shop Head Shade

TO PREVENT drying out or otherwise injuring the complexion of beauty-shop customers, a novel beauty hood, shown above, is now in use. Worn around the head like a lamp shade over an electric bulb, the cardboard protector blocks off heat and light radiations from the electric hair drier.

Edger Protects Papers

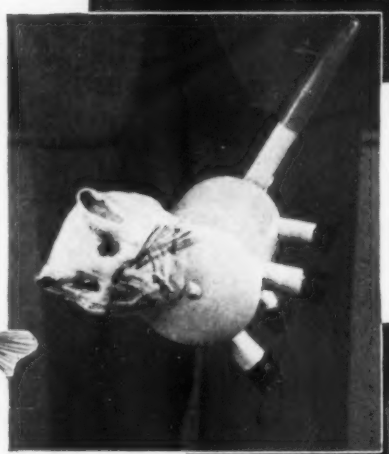
BLUEPRINTS, diagrams, leaflets, and other papers which are constantly being handled can be protected from becoming torn at the edges by a new machine that automatically cements a strip of strong transparent paper to the edge to be protected.

A turn of a crank applies the edging to the paper

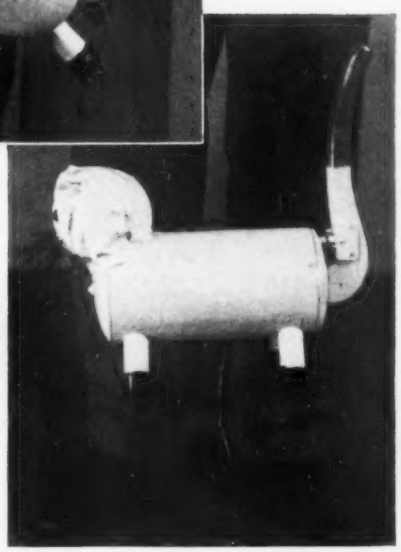
WHY DO Cats Always Land ON THEIR FEET?

WHY does a cat always land on its feet, when dropped upside down? Because it flips itself over with its tail," says an engineer who has built an animated model of wood and clay to demonstrate the idea. When his mechanical kitty is inverted and dropped, a spring mechanism spins its tail through an arc and it rights itself in mid-air, striking the floor upon all four feet.

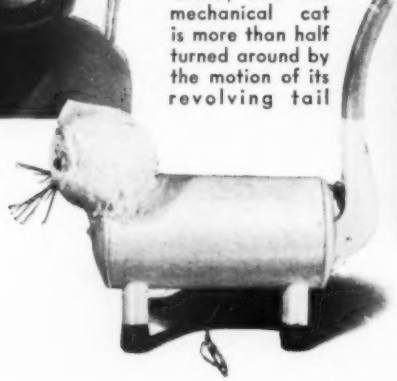
1 Below, left, setting the dummy wood-and-clay cat for the test. Its tail is turned by a spring action when it is dropped. Its center of gravity and weight distribution are the same as those of a real cat



2 Upside down, before the test. Releasing the cord to drop the dummy cat starts the action that turns the long wooden tail



3 Halfway to the floor, above, and the mechanical cat is more than half turned around by the motion of its revolving tail



4 Almost on the floor, and the cat is completely upright. The tail, which automatically stopped turning, has stopped kitty from turning, too

5 Happy landing, with all four feet under it and all nine lives still intact, at right. Ordinary rubber cane tips serve as feet to help cushion the shock

Instruments Tested in Cleaned Air

TO INSURE the utmost accuracy when checking transport-plane instruments, the Pittsburgh, Pa., testing laboratory of the Pennsylvania Central Airlines has been specially air-conditioned to keep out any traces of moisture as well as dust which might affect altimeters, directional-flight instruments, and other delicate apparatus. Every important instrument in the planes is required to be checked after each 650 hours of use.

Technician overhauling airplane instruments in an air-conditioned laboratory

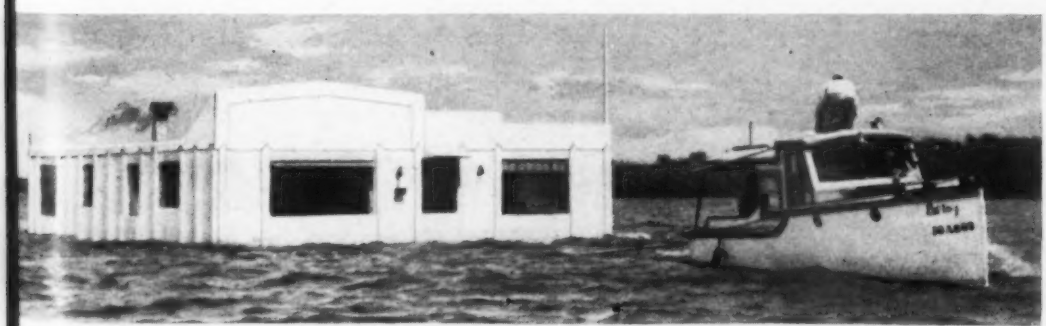
Headlight Fits Electric Razor

Razor fitted with housing for light bulb. Left, the illuminated shaver in use

ELECTRIC razors can now be equipped with a headlight that illuminates the area just in front of the cutter, as a New York City firm announces an electric-bulb attachment that will fit most makes. The bulb is shielded in a plastic case that fits against the side of the razor, giving shavers a concentrated light on their faces.

Ready-Built House Floated Across a River

INSTEAD of having his new prefabricated house delivered by truck, a Peoria, Ill., home buyer had the eight-room structure floated across the Illinois River to the building site on the opposite shore. Drawing only eight inches of water, the forty-one-ton steel building was towed by a power launch as seen in the photograph below.



He Builds Fire Engines for

One of Smillie's jobs—the streamline truck he built for the town of El Cajon, Calif.

La Mesa, Calif., volunteers fighting a grass fire. Their trim equipment was assembled from spare parts and junk-yard relics

SIREN shrieking, a rakish streamline fire engine careers through the streets of a southern California town. It is manned by volunteer firemen. Looking at the flowing lines and gleaming finish of the vehicle, you would never suspect that it was a standard chassis fitted up with spare parts. You would not believe that the sweeping rear fenders had once covered the front wheels of a commercial truck, or that the siren was a homemade job turned out of a pair of discarded brake drums and an electric starter motor!

Both car and siren are creations of John Smillie, a San Diego metal worker who builds up fire engines for small communities in the Southwest. From such materials as he can buy from junk yards and parts dealers, Smillie turns out fire-fighting equipment rivaling in beauty and efficiency the more costly units seen at fires in every big city.

Most small towns maintain volunteer fire departments. Citizens of all classes band together for the common good, fighting fires without pay. When volunteers in California towns raise funds for new trucks, they often promise subscribers that Smillie will build the equipment. Recently R. M. Halgren, chief of the La Mesa department, and his eight assistants collected $1,000 privately, obtained additional money from the town council, and set the truck builder to work. Shortly he delivered a streamline vehicle with the promise, "she'll go faster and unload hose faster than any other in the state."

Volunteer Smoke Eaters

GIVE JOHN SMILLIE A CHASSIS AND A FEW SPARE PARTS, AND HE TURNS OUT A MODERN PIECE OF FIRE-FIGHTING EQUIPMENT

By

JOHN E. LODGE

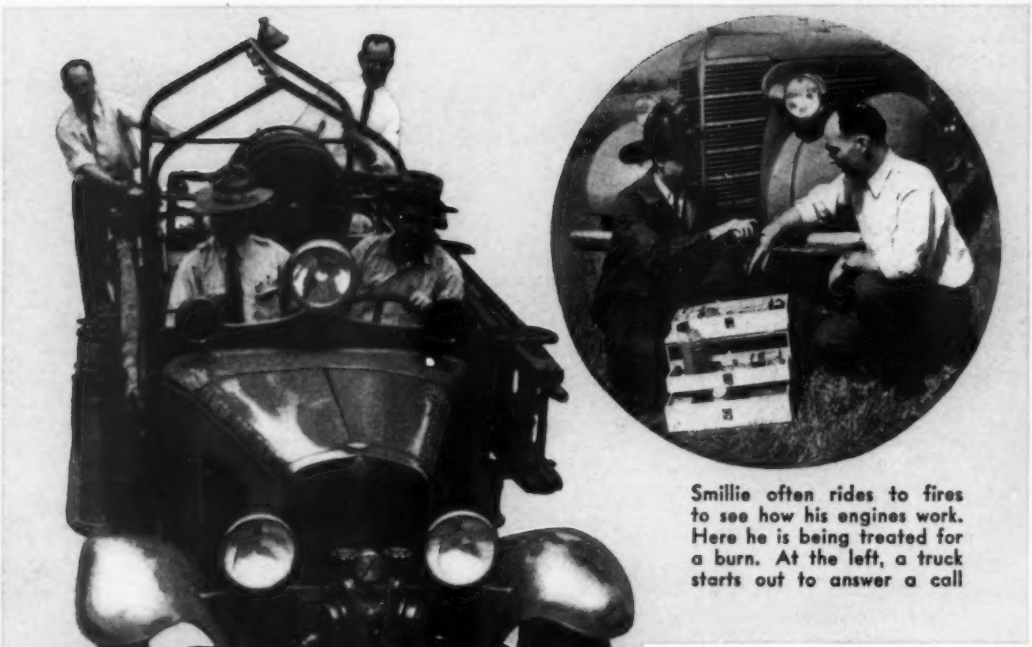
A volunteer in action. Small-town fire fighting calls for good equipment at low cost

Halgren determined to test Smillie's promise, and one night, when the truck was standing just outside the town at a grass fire, he sounded the alarm. Forty seconds later one volunteer fireman dashed up to the fire house, within another eight seconds three additional crew members arrived, and within one minute and thirty-five seconds after the siren began to blow all nine firemen, including those on the truck, had answered the call.

On another occasion, in response to a night alarm, five of the boys answered a fire alarm, reaching the blaze in ninety seconds, and the truck was backed into the fire house eight minutes after it first began to roll. Staggered racks for hose lines, an original design with Smillie, enable the crew to unload hose rapidly.

When a fire marshal visits Smillie's backyard metal shop to leave an order for a new

John Smillie at work on a staggered hose rack, an invention that speeds unloading



Smillie often rides to fires to see how his engines work. Here he is being treated for a burn. At the left, a truck starts out to answer a call

piece of equipment, he usually delivers a chassis and a vague order to "fix her up." From experience, Smillie knows how many gallons of water the truck engine will pump, how much hose the truck should carry, how to arrange ladders and racks and axes for speedy handling.

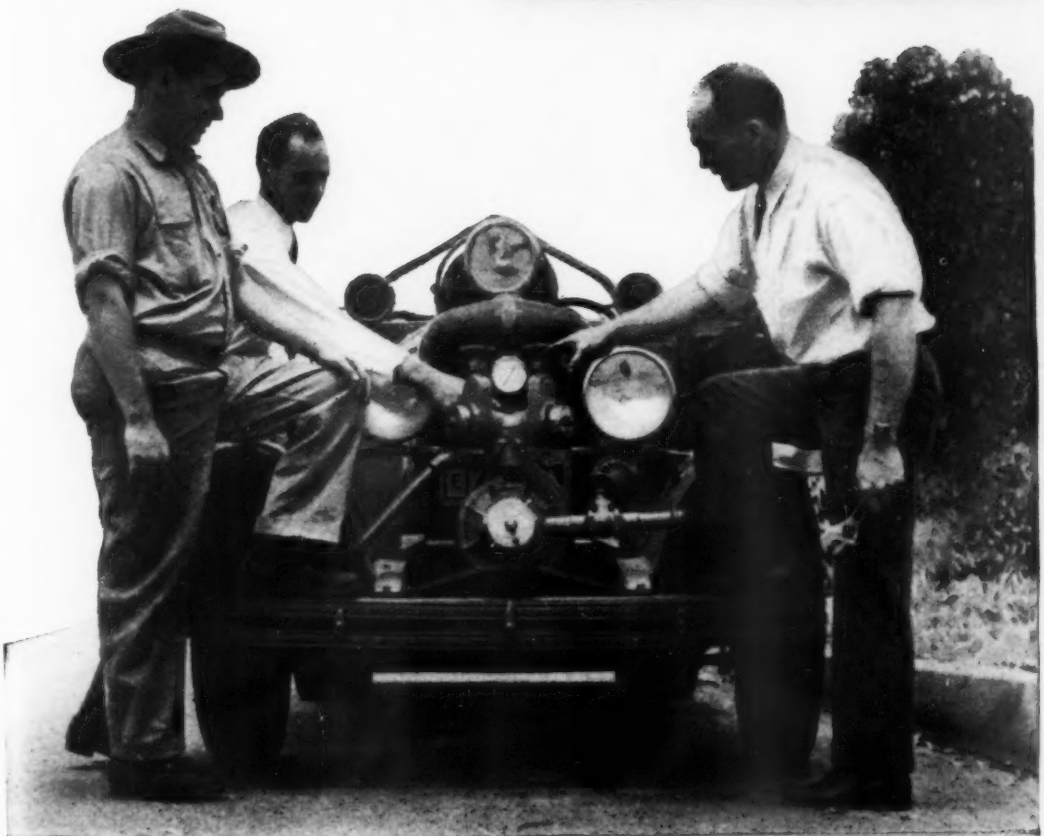
He seldom "engineers" a job, but develops it as he goes along. On the La Mesa job, for example, Smillie installed a set of pumps, completed the seats and body, and then found he could not purchase a siren at the price La Mesa's volunteer department expected to pay. In a San Diego junk yard he found two old brake drums. With a hack saw he cut slots through which air could pass under pressure. He cast an aluminum plate to serve as a drive fan and throw air through the slots. Finally, he bought a starter motor for three dollars. The motor turned the plates, which cut the air on and off, thus creating a high-pitched siren at a cost of $9.50, only one eighth of the price of a new one.

Smillie builds any type of fire-fighting apparatus ordered by his customers. Whenever he reads of a big blaze outside the cities, he anticipates a call for an unusual job. Some time ago, newspapers told of a mysterious fire destroying a railroad tunnel near Carisso Gorge, between Imperial Valley and the Pacific Ocean. Railroad crews had no way to deliver *(Continued on page 230)*

This metal cop, made by Smillie, warns motorists

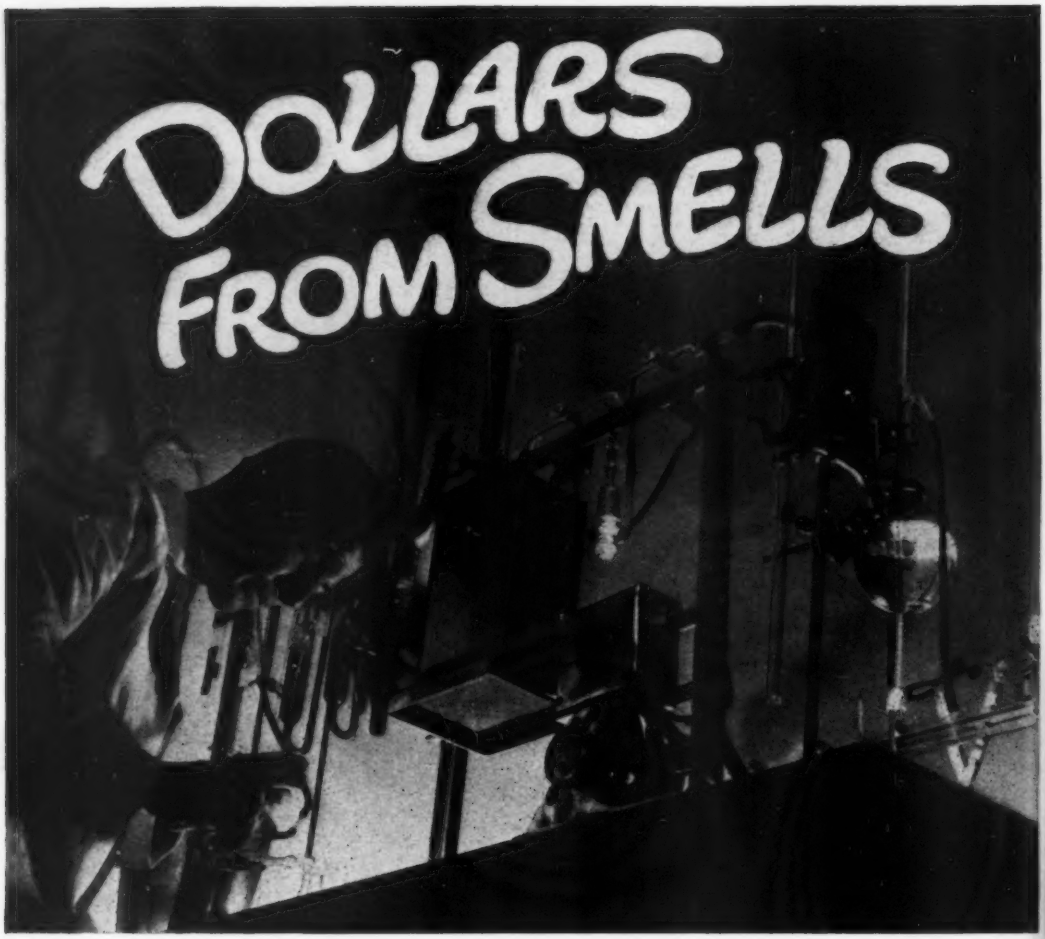
For trucks to be used in the country, Smillie recommends two pairs of rear wheels fitted with heavy, ridged tires to give traction in wet earth

The homemade siren below was improvised from a pair of discarded brake drums and a starter motor



In rural districts, fire trucks must be powered to suck water from wells and canals. The La Mesa outfit, pictured above, has its pumping arrangement mounted at the front

DOLLARS FROM SMELLS



DEEP in the workings of a western mine, a burly power-hammer operator stopped nudging his chattering rock drill against the face of the drift, and sniffed the air.

"I smell skunk!" he shouted. His voice was drowned in the roar of the pneumatic hammers, but the lights began to blink rapidly, in a series of triple flashes.

His companions looked around and also sniffed the air.

"Fire! Fire!"

With one accord, they dropped their tools and raced to the "skip" leading toward the surface. In the throbbing silence that followed the clatter of the hammers, distant gongs spread an alarm that was carried to all parts of the mine.

Artificial skunk odor now is used in many large western mines to carry the warning of fire. A few drops of butyl mercaptan, an aromatic fluid produced in the laboratory, are injected into the air-circulating system to create a vapor that is shot through ventilation lines at thousands of feet a second, flashing a silent warning that penetrates where a gong could not be heard. This synthetic smell is one of many recent creations from the test tubes of the "smell experts," chemists who tailor odor-producing materials to fit the needs of industry. Sometimes the desired odor is a delightful perfume, sometimes a harsh stench; more often, it is an aroma skillfully counterfeiting some odor of nature.

Good-smelling paint; fragrant linoleum, ink, and oil; deodorized raincoats, hot-water bottles, oilcloth, and furs—these are some of the smell experts' latest contributions to

MAKING ODORS TO ORDER, CHEMISTS REPRODUCE NATURE'S INNUMERABLE SCENTS, AND EVEN INVENT A FEW NEW ONES

By STERLING GLEASON

•

pleasanter living. A few ounces of a new mixture of aromatic substances may be added to each 100 pounds of raw rubber to offset the natural odor or give a floral perfume. Wall paper now is available in mild, inoffensive odors that give character to the room. Catalogs no longer smell mustily of paper and printer's ink, for synthetic aromatics added in manufacture subtly create a favorable impression of the goods advertised.

Recently, a silverware manufacturer whose business was sliding downhill repackaged his goods in boxes fastened with a pleasantly fragrant glue. As a result, sales rose sharply. It's a tradition that certain fabrics woven in Scotch and Irish mills hold the smell of peat smoke, but American odor specialists were convinced that the smell must be artificial, because there seemed to be no more possibility of acquiring peat smell there than in a Massachusetts factory. They discovered how to distill dry peat and dissolve the product in deodorized gasoline, producing a liquid that could be sprayed on tweed fabrics to give the familiar odor. Again, a Chicago hotel charmed summer guests by giving its ballroom the invigorating, tangy air of the north woods through a "carburetor" which dripped pine oil into the air-conditioning system at the rate of a quart every eight hours.

Psychology plays a prominent part in this delicate work. A commercial odor must not only be pleasant, as a rule, but must seem genuine as well. No matter how closely an imitation-leather wallet may resemble the real thing, you'll find it more satisfactory if it actually smells like leather. American buyers seemingly didn't care for imitation Asiatic shawls until chemistry gave the goods an authentic "oriental" odor. One smell expert now is working on the problem of giving a fragrance to ladies' shoes. And when a complete model coal mine was set up in the Chicago Museum of Science and Industry, the final touch of realism was an earthy smell especially designed for the purpose.

Most synthetic smells are promptly patented, and the discoverer of a new one may earn a substantial fortune. Natural musk, extracted from the glands

A $10,000 whiff from a large bottle of perfume in a Los Angeles, Calif., laboratory. At right, a chemist testing a new blend. He is sniffing strips of paper dipped into the various essential oils

The osmoscope being used to test the odor left on the breath by a cigar. It shows the strength at which a smell is noticeable

Artificial skunk odor, introduced into the air-circulating system of a coal mine, warns workers of fire when an alarm gong could not be heard

of the musk deer of Tibet, formerly brought as much as $2,500 an ounce—but chemists learned to produce a synthetic musk that cost but a fraction as much. Such opportunities for profit are stimulating the search for a wide variety of other aromatic substances to meet the specific needs of manufacturers.

How does a smell expert set out to create a desired odor?

If he is seeking a floral perfume, the problem is relatively simple. "Essential oils," extracted from the flowers themselves, have been used since history began, and these materials simply need to be combined according to the taste of the designer.

Chemists know that noticeable odors are given off only by things possessing a low "surface tension." A good perfume material, therefore, has a weak "skin" which permits vapors to break loose and rise to the nostrils. In blending perfumes, you simply dissolve from one to a dozen known odor-bearing materials in a pure, odorless alcohol, then add a "fixative," a substance which lowers the surface tension and allows the odors to escape freely. Before modern chemistry came to the rescue, fixatives generally used were musk, civet (from the civet cat), ambergris (produced by sick whales), and castoreum (from beavers).

One by one, these substances, as well as other common perfume ingredients, have been supplanted to a large degree by substances produced in the laboratory. Twenty-

"Peat-smoke" odor, supposed to identify imported tweeds, can be given to any fabric by the use of a spray

five tons of violets formerly were needed to yield a single ounce of violet oil, which chemists now can simulate from oil of lemon grass at relatively small cost. "Carnation" is produced from oil of cloves; "new-mown hay," from the distillation of coal. Even evil-smelling substances such as skatole, actually derived from putrefied animal matter, are used as the basis of some of the very best perfumes. Additional "colors" constantly are being added to the perfumer's palette.

ONE Los Angeles amateur took up the blending of perfume as a hobby, but the fame of his compounds spread so that now he makes a business of creating individual blends to order for Hollywood movie stars. One creation, which he calls the "Flower Lei," represents the fragrance of various native flowers of the Hawaiian Islands.

Perfumes like these, however, are merely mixtures of well-known scents. A smell expert will tell you that "odors mix, but never combine." Certain types of chemical structures are known to be "aromatic"; but predicting exactly how a synthetic material, fresh from the test tube, will smell, is virtually impossible. That means that usually a new odor-producing substance is found only through a long, tedious process of trial and error, perhaps lasting for years.

Such a quest began when chemists of a company distributing natural gas were handed a strange assignment—to give the company's product a characteristic smell.

Contrary to general opinion, pure natural gas, unlike the manufactured variety, is completely odorless. It also is nonpoisonous. You might die of suffocation in a room filled with natural gas, after you had breathed up all the oxygen the air contained, but the gas itself would never harm you. When a gas leak develops, however, there is always danger of fire or explosion. The company wanted to "tag" its gas with an odor that would be unmistakable, as well as free from bad effects when burned. A pleasant odor wouldn't do, for customers might like to smell it and let leaks go unmended. It should suggest gas, too, so that anybody smelling it would get the right idea at once.

Natural gas is odorless, but an artificial "gas" smell added to it enables this housewife to locate a leak in a connection

Dozens of complex chemicals were tried before chemists hit upon a suitable material —a harsh, disagreeable-smelling liquid extracted as an impurity from gasoline during refining. When greatly diluted, it has a distinctive odor that instantly suggests a refinery or an oil well. Chemists adjusted its proportions so that it would be detected when the amount of gas escaping into a room reached one percent. Natural gas isn't explosive until the concentration reaches five percent. That meant that the gas could be smelled long before the leak assumed dangerous proportions —even if the smeller had a nose cold, or if cabbage was cooking in the kitchen. The refinery was glad to get rid of this formerly useless by-product, and the gas company now buys it by the tank-car lot, putting some 200 gallons of it into each 100,000,000 cubic feet of gas.

Smell experts often have to be trouble shooters when obnoxious odors create difficulty. Not long ago, residents for several miles around were troubled with a very bad odor originating in a packing house. A chemist traced it to a sewer line where the fumes had condensed in

Buyers like artificial-leather articles that smell like the real thing. The chemists took care of that little detail

These flasks, in a California laboratory, hold a fortune in rose-petal extract imported from Belgium. Sheepskin covers protect the contents in any climate

a small trickle of water. Adding a liberal dose of chlorine quickly cured the trouble. A manufacturer of fish fertilizer was cordially hated in a near-by residential district until he called in an expert who devised a retention chamber in which chlorine gas neutralized the nauseating fumes. Scents from the manufacture of linoleum and oilcloth are particularly offensive. More than one manufacturer has made his employees happier by eliminating odors which formerly would linger in the clothing for twelve to fifteen hours after they went home from work.

In studying an undesirable odor, the smell expert usually wants first to measure its strength. For this purpose, no substitute has ever been found for the sense of smell. "Mechanical noses" of various kinds have been contrived, but all of them require the human nose to identify the odor. The smell expert, however, has one useful auxiliary instrument: the "osmoscope," which consists of a nosepiece attached to a pair of calibrated tubes—one to draw the air from a bottle containing the odor, the other to dilute the odor with pure air. The expert then "trombones" the sliding tubes, sniffing all the while, until he finds the weakest dilution which still has a noticeable smell. Thus he measures the "threshold" strength of the odor, which may range as low as a billionth part of a gram to every quart of air.

One large tobacco manufacturer, anxious to show the superiority of a nationally known brand of cigars, had a smell expert collect the breath of men after they had smoked various kinds of cigars. With the osmoscope, he measured the amount of odor that remained, and was able to demonstrate scientifically that his brand left the least "after-breath."

Biggest smell-eliminating job of today is the problem of taking the odors out of "conditioned" air. Most air-conditioning systems "recirculate" the air again and again and the accumulated odors grow in strength until they become obnoxious. Dr. Philip Drinker of the Harvard School of Public Health, classifies the three most common as foodstuffs (comparable to hydrogen sulphide, the "rotten-egg" gas), human smells (people needing baths—similar to butyric acid, found in rancid butter), and tobacco smoke. All are extremely persistent and can be detected when present only as a few parts in 1,000,000,000 parts of air.

They can all be eliminated to some extent by absorption in a cold liquid such as cold water or brine, thus dissolving out the soluble gases; by diluting with clean air until they are too faint to be detected; by filtering through charcoal or activated carbon; or by oxidation—literally burning up impurities with ozone.

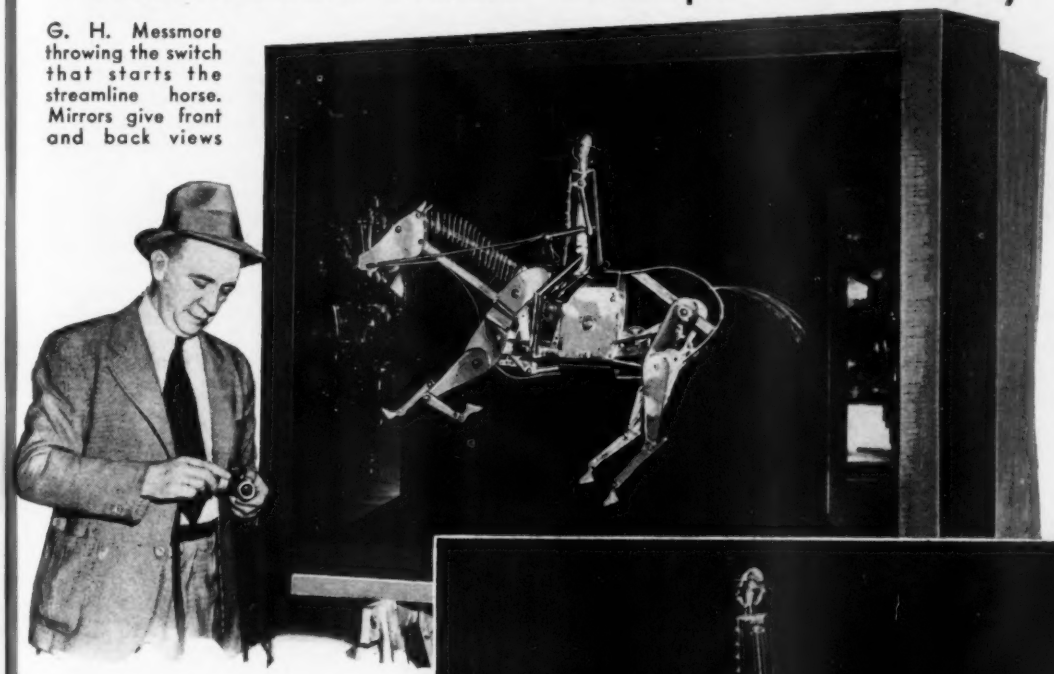
PROF. John Madigan, of St. Thomas College, worried by poor marks being made in his physics class, hit upon a chemical grading system for examination papers. He put them into three jars; sprinkled the best group with attar of roses, the poor ones with hydrogen sulphide, and the failures with butyric acid; then invited students to pick out their papers.

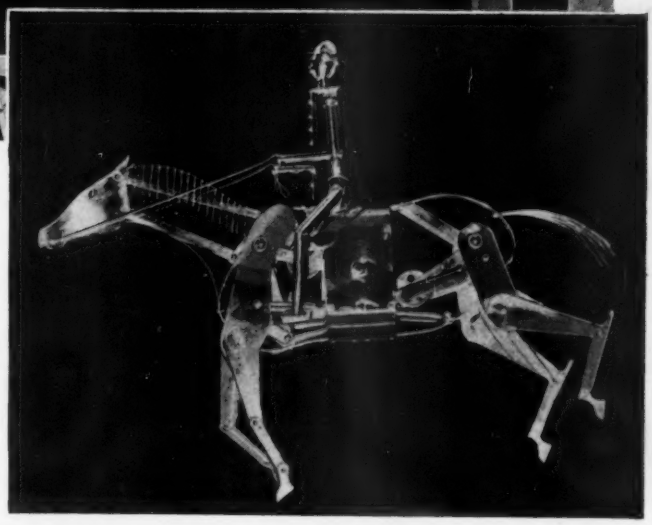
"It wasn't necessary to tell them whether they had passing grades," commented the professor. "They 'sensed' that."

Result of the unique grading system was a thirty-percent average improvement on the next examination.

Mechanical Horse Gallops Realistically

G. H. Messmore throwing the switch that starts the streamline horse. Mirrors give front and back views





TO SERVE as a symbol of "horsepower" for an exhibit at the New York World's Fair, Messmore and Damon of New York City, famous makers of animated exhibition models (P.S.M., June '32, p. 16), have completed a streamline, mechanical horse whose lifelike galloping action is said to have amazed experts. An intricate composite of chromium-plated metal parts, the symbolic steed is flanked by mirrors which give front and back views.

Each map page in the atlas has a tab for ready reference

Visible Index on Atlas Locates Maps Quickly

HANDY for students, research technicians, and office workers is a new loose-leaf atlas of the United States equipped with a visible index making it easy to find the map and statistics of any state. The atlas cover, hinged at the left, opens to reveal a map of the nation on the inside, while state maps are printed on pages hinged at the top, at the right. Because the complete United States map is visible at all times, regardless of which state map is being used, comparisons can be made easily, without turning a page.

Make-Believe Crimes

JUST as an army holds war games, the police department of Pasadena, Calif., now holds "crime games" to train officers in the use of science in their search for clews. Mock murders, make-believe suicides, counterfeit hit-and-run accidents, keep the detectives on their toes. Several times a month, they answer emergency calls and find synthetic crimes awaiting solution. Only by employing the latest scientific methods of detection are they able to discover vital clews.

During the two years that this unusual system of instruction has been in operation, every active member of the force has been trained as a scientific sleuth. And, what is more important, the list of unsolved crimes in Pasadena has been cut almost to the vanishing point.

Here is a typical leaf from the exciting "text-

Suicide—or murder? The only clews are a gun and an empty shell

A little dirt in the shell case supplies the answer for this problem presented to cops by the Pasadena, Calif., crime school

Answering the radio call, detectives and motor-cycle policemen rope off the "crime" car and hunt for telltale evidence

Police Photographer F. O. Gould, at left, sets up his camera and snaps the scene from various angles

Train Scientific Sleuths

book" studied by these western crime fighters:

It is mid-afternoon. From police headquarters, radio flashes the following message: "Calling cars 23 and 24. Dead man in automobile near road camp on Arroyo Seco. Motor cycles 7 and 8 proceed for assistance."

Detectives and police officers race to the crime scene. Motor-cycle officers arrive a moment later. Under the sheltering branches of an oak tree, they find—not a corpse, but a trusty from the city jail. He is slumped over the wheel of a car as in death. Near-by stands Police Photographer Fletcher O. Gould, his camera trained through the open door on the prisoner.

The cars pull up to form a triangle with the death automobile. Four officers quickly string ropes around the cars and near-by trees, and motor-cycle cops take up positions to keep out the gathering crowd. The detectives examine the "victim," and direct a search for physical evidence. The exterior of the car is checked for fingerprints, and Gould takes photographs of the entire scene, including close-ups.

On the seat near the prisoner's right hand an automatic pistol and an empty shell case are found. The floor is free of dirt, and in a pocket is found a suicide note. Holding the pistol with two fingers, one of the detectives transfers it to a transparent envelope. He picks up the shell, turns it over carefully in his hand. From it falls a small amount of dirt.

By
ARTHUR A. STUART

•

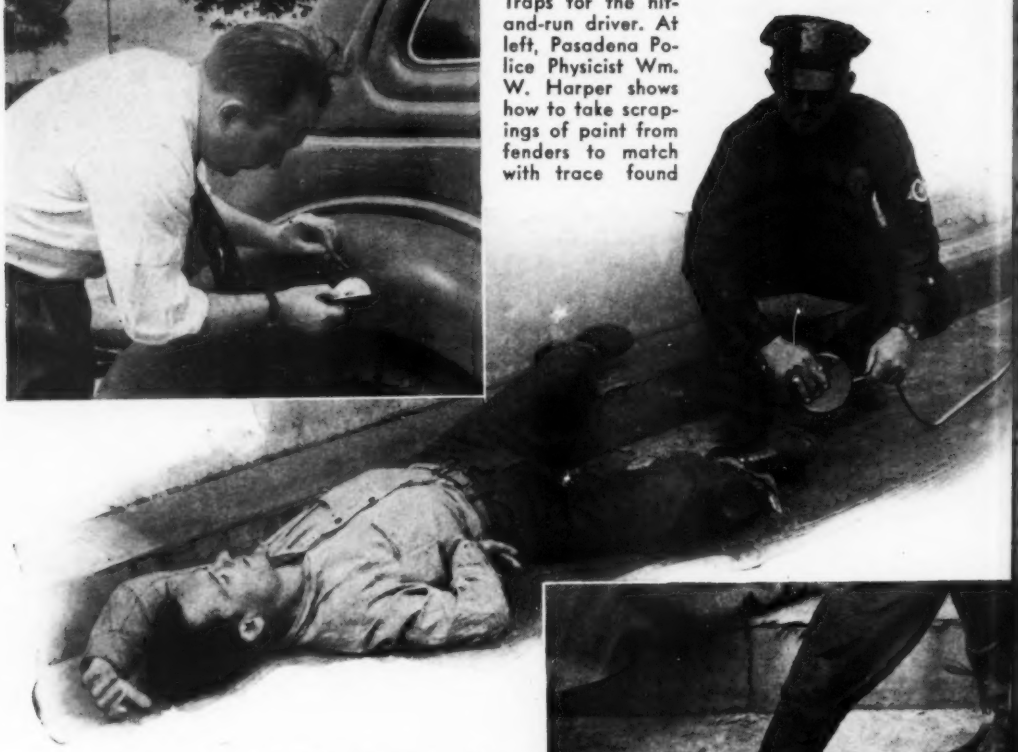
Make-believe murder. A detective sets the stage for an imaginary mystery by acting out the supposed crime, leaving clews for the police students to unravel

•

This is what the police find when they reach the scene. On the surface, it looks like a suicide

At the left, an investigator is carefully placing the "death gun" in a transparent bag to preserve fingerprints. Close observation and scientific sleuthing provide the correct answer—"murder"

Traps for the hit-and-run driver. At left, Pasadena Police Physicist Wm. W. Harper shows how to take scrapings of paint from fenders to match with trace found



A police officer measuring the location of a "body." He learns to look for clews like headlamp glass in a trouser cuff, at right

"Diagnosis homicide," he reports to headquarters that afternoon. "Shell case on seat of car contained small trace of sand corresponding to that found around car. Shell carelessly placed in car to support a suicide picture."

Pasadena, like many cities, was suffering two years ago from too many unsolved crimes. Hit-and-run drivers escaped arrest. Apparent suicides may have been murder victims. Police physicists and chemists worked wonders with the scant evidence brought in, but Chief Charles H. Kelly knew laboratory findings were no more complete than the evidence found at the scene of the crime. He called in Chief of Detectives Stanley Decker and Police Physicist William W. Harper. "Microscopes and laboratory examinations are not enough," he told them. "Police officers themselves must go scientific. I want each officer on our force to know how new laboratory equipment affects his work."

From that conference came Pasadena's unusual crime school. It is not only a classroom study of books. Officers respond to radio calls, never knowing whether they are rushing to the scene of a real crime or will find some trusty, or perhaps a dummy, the cau of whose "death" they must determine fro clews that they can find.

A radio flash sent plain-clothes men to downtown office building. There they fou a trusty slumped toward a typewriter on small table, his back against a roll-top desk Near-by stood Chief Decker, who directs th school.

"What is it this time, boys?" he grinne "Suicide?"

Without answering, the detectives bega their investigation.

"We stipulate," Decker went on, "wound i right forehead with considerable hemorrhag and another wound in rear of head with slig bleeding. No powder marks are visible."

An hour later, the officers handed Decke their reports. "Circular traces of blood ind cate man had been revolved in chair afte being shot," they found. "Nature of bleedin from both wounds showing bullet entere

rom rear. Automatic vas found unloaded nd slide not back, indicating it was closed nanually after being ired." Each officer correctly diagnosed the "crime" as murder.

Several motor-cycle officers were rushed to point below Pasadena's famous "suicide ridge" the other day. Looks like he jumped, oys," said the radio dispatcher. They roped ff the area around he "body" and made he usual photographs nd measurements. Then one noticed several small, green eaves adhering to one lbow. No such leaves were growing nearby. Another officer detected a small piece of roken headlamp glass ucked away in a trouer cuff.

Chief Charles H. Kelley examining the dactyloscope, a magnifying projector used by students of the Pasadena police school for identifying fingerprints

"This guy didn't ump," they unanimously decided. "Some river hit him, brought him here, and ran."

Little things—blood, hair, glass, dirt—often rove the deciding factors in diagnosing a rime. Not long ago, a staged accident brought our policemen to a dark street. This time hey found a dummy lying outside a car, which was jammed against a telephone pole. It looked like a crash in which the driver had died. But they were not satisfied. Exploring the car minutely, inside and out, they discovered two red hairs stuck to the window in the left door with red wax. The dummy had black hair.

"Manslaughter, not accident," they decided. The theoretical driver of the car, injured when he struck the glass, had fled.

Five days later, the same group of officers received a hurry-up call to the scene of a real accident. There they found two boys and a girl, all injured. There followed the usual crime-school investigation, which revealed three hairs from the youth sitting on the right side, stuck in a blood clot on the jagged edge of the broken windshield. Later, when the other boy, whose head was uninjured, denied having been at the wheel, photographs of the hair and his friend's cut head induced him to confess.

"If you pull a crime in our town," says Chief Kelley, "you stand a better-than-average chance of being caught and convicted. We will back up all our charges against you with proof. Hairs from your head, a broken lamp from a headlight, fabric from your coat, fingerprints. If you are guilty, we will connect you with the crime so clearly that no one else could conceivably be the culprit."

One proof of the crime school's success lies in Pasadena' record of hit-and-run convictions. Only one case is unsolved.

hattered glass teaches officers how to determine rom which side of a windowpane a bullet was fired

Big Farm Tractors Go Modern

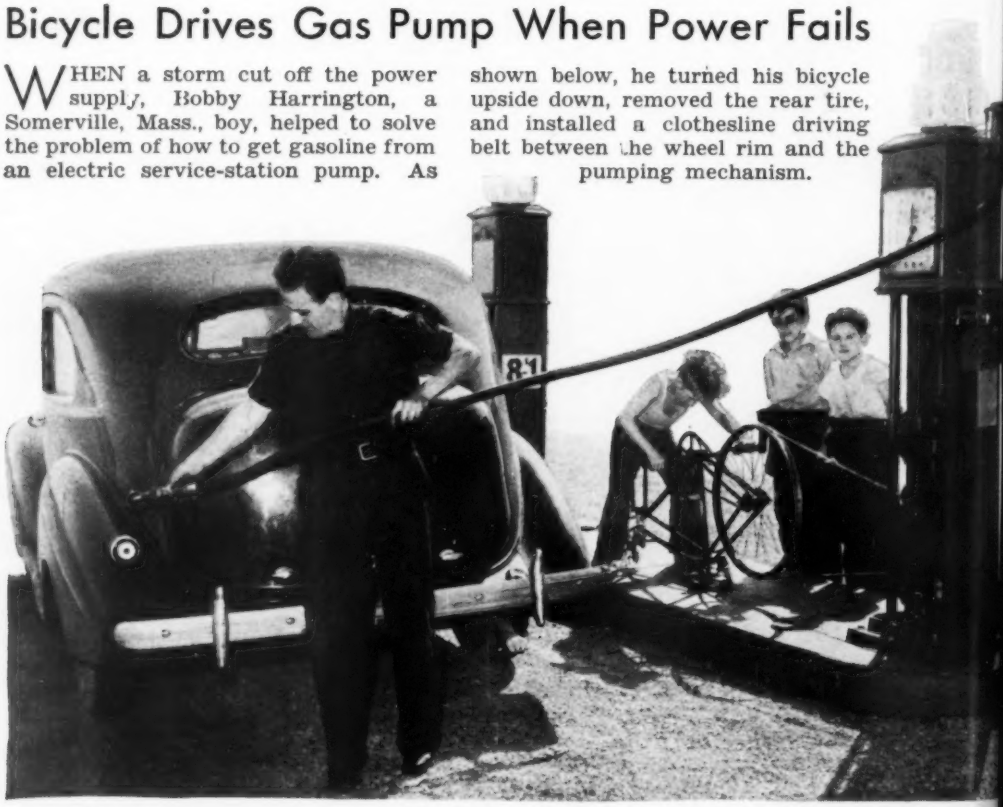
PLOWING should be sheer luxury to farmers who own a tractor now being manufactured with most of the comforts, conveniences, and accessories of a modern passenger car. Fitted with giant, rubber-tired rear wheels and a powerful high-compression engine, the tractor boasts of streamline headlights, an inclosed cab, a complete instrument panel, cushioned seats, and even a radio.

Novel Desk Phone Has Pull-Out Dial

DESIGNED for desk us a new English ha telephone fastens within t knee space of a desk, n of the way. The dial pulled out into full vie when calls are made.

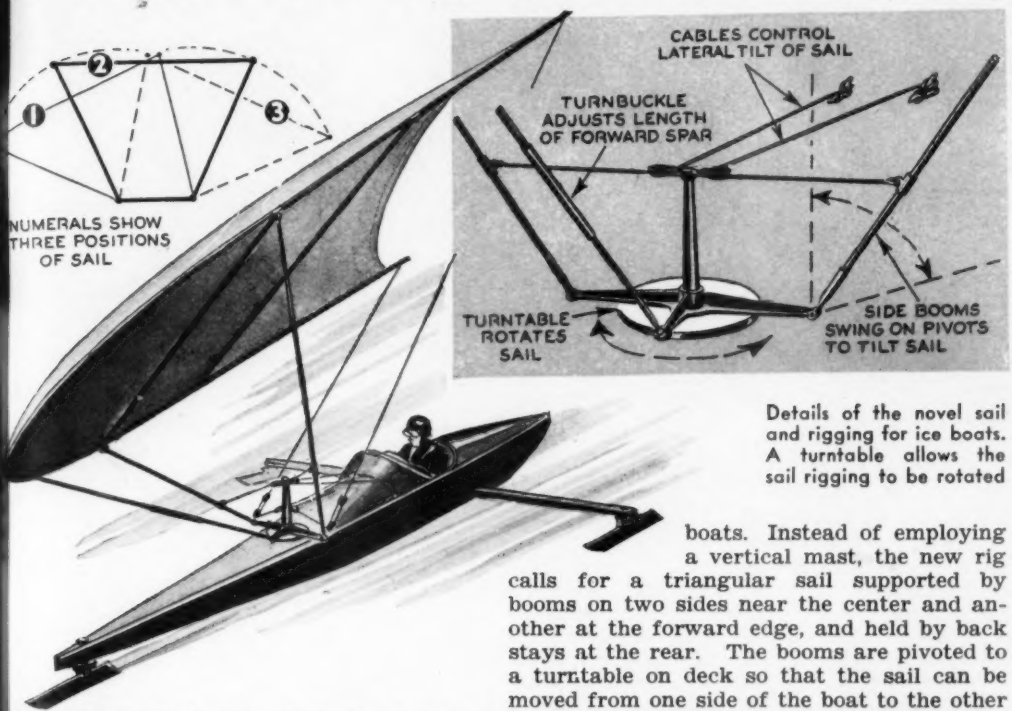
Bicycle Drives Gas Pump When Power Fails

WHEN a storm cut off the power supply, Bobby Harrington, a Somerville, Mass., boy, helped to solve the problem of how to get gasoline from an electric service-station pump. As shown below, he turned his bicycle upside down, removed the rear tire, and installed a clothesline driving belt between the wheel rim and the pumping mechanism.



A boy's bike supplied power for this service station's gasoline pumps after a storm cut off the electric

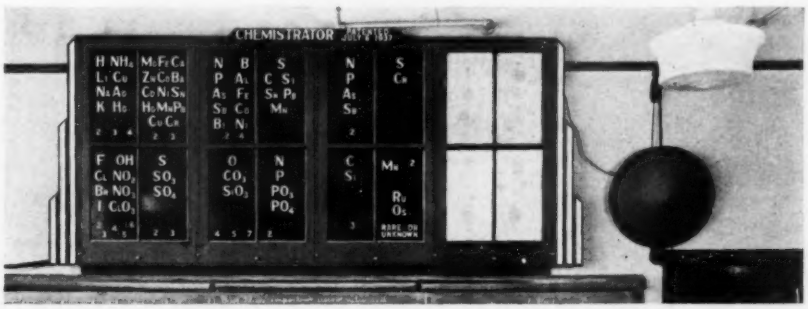
ce Boats Get New Speed with Odd Rig

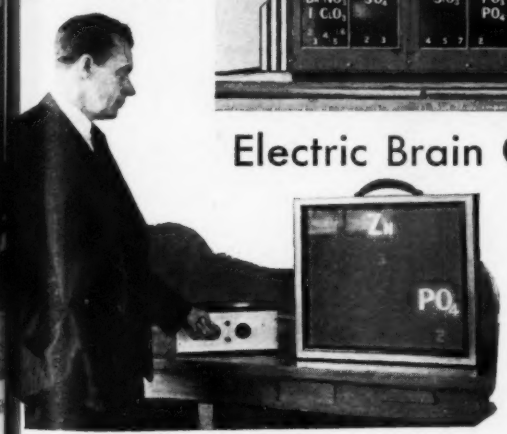

CABLES CONTROL LATERAL TILT OF SAIL
TURNBUCKLE ADJUSTS LENGTH OF FORWARD SPAR
NUMERALS SHOW THREE POSITIONS OF SAIL
TURNTABLE ROTATES SAIL
SIDE BOOMS SWING ON PIVOTS TO TILT SAIL

Details of the novel sail and rigging for ice boats. A turntable allows the sail rigging to be rotated

ALTHOUGH designed principally for use on sailboats, an ingenious sail rigging vised by a Californian also provides excepnal stability and maneuverability for ice boats. Instead of employing a vertical mast, the new rig calls for a triangular sail supported by booms on two sides near the center and another at the forward edge, and held by back stays at the rear. The booms are pivoted to a turntable on deck so that the sail can be moved from one side of the boat to the other when changing course. The turntable is controlled by a tiller wheel, while a cable-and-pulley arrangement is used to adjust the sail laterally to catch the wind.

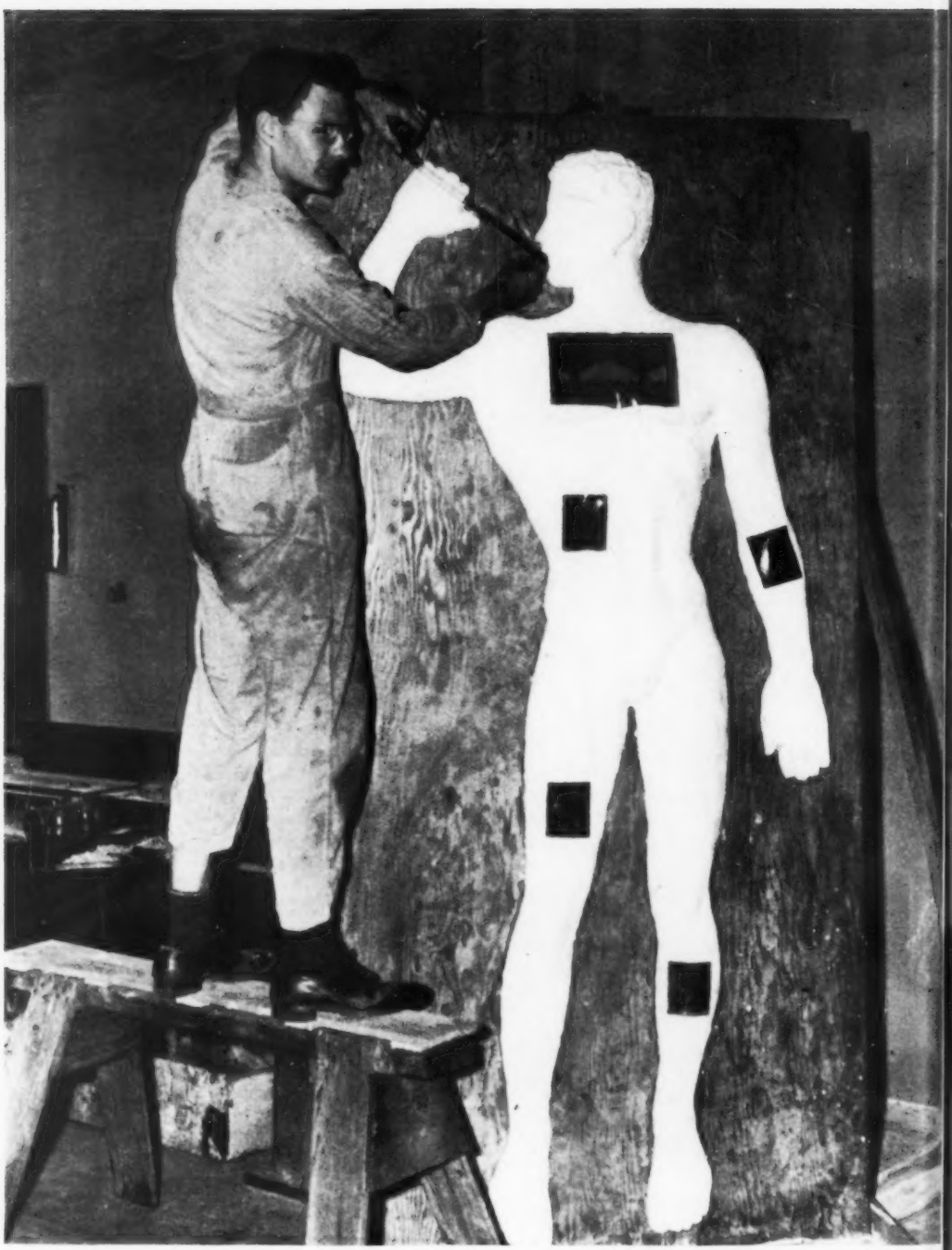
e mechanical forlator which tells w chemical eleents combine. At right is a classominstallation, and elow is a small monstration model





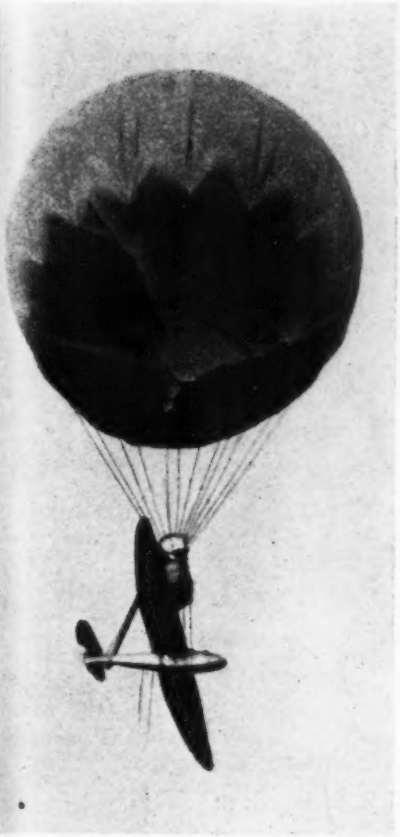
Electric Brain Gives Chemical Formulas

AN ELECTRIC "brain" automatically produces the formulas of familiar chemical compounds, in a new educational aid for schools and colleges designed by H. S. Van Doren of Great Neck, N.Y. Turning a knob on the control panel of the device "mixes" any desired pair of ingredients. Relays light up the corresponding chemical symbols, together with numerals that show their proportion in the resulting compound.



Manikin Illustrates How Radium Fights Cancer

DESIGNED by scientists at the University of California, a giant bas-relief figure of a man will show visitors to the San Francisco world's fair how radioactive substances are used in the control and treatment of cancer. Pressing a button will send varicolored spheres representing radioactive substances down a tube into the manikin's body, and printed legends will appear simultaneously to describe the effect on various areas



The balloon-glider shortly after the take-off

Lifted Three Miles by Balloon, Glider Drops at 100-Mile Clip

RUSSIAN aviators recently made history by a daring balloon-glider combination flight into the substratosphere near Moscow. With the glider suspended beneath it, a balloon took off, soared to an altitude of over 16,000 feet within three quarters of an hour, and then released the glider which was guided down to a landing by its pilot at a speed of 100 miles an hour. Aviation authorities regard this feat as a demonstration of the practicability of using gliders for emergency descents in stratosphere-balloon ascensions.

Humidifier Fits Cigarette Pack

COMPRESSED under tremendous pressure, blocks of a mineral substance encased in small cellulose tubes are now available as compact tobacco moisteners that fit in humidors, pouches, and cigarette packages. Kept damp by a tiny built-in water reservoir, the small mineral block releases water vapor, no actual liquid being freed at any time.

Flash Bulb on Hat Leaves Cameraman's Hands Free

FOR snapping night photographs of badgers and other wild life the ingenious photographer pictured at the right rigged up his small-size flash bulb and reflector on the top of a military trench helmet worn on his head, leaving his hands free. The flash bulb is synchronized with the camera shutter.

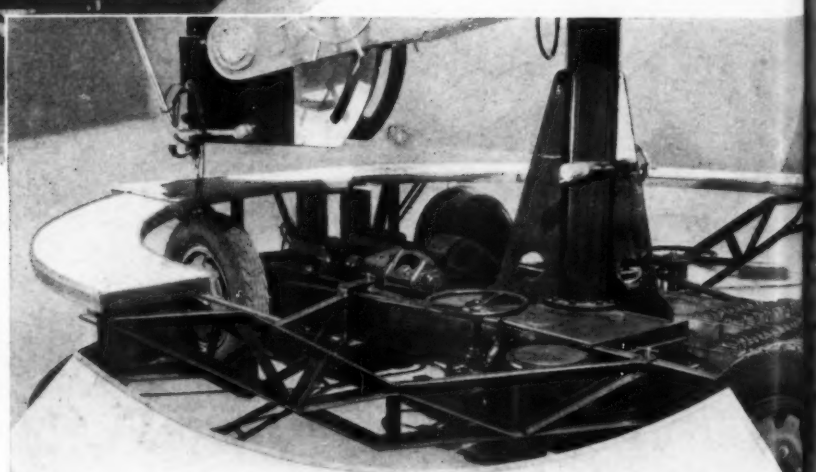
With his flash-bulb reflector atop his hat, the photographer's hands were free to take picture at left

Mobile Crane Aids Movie Mer

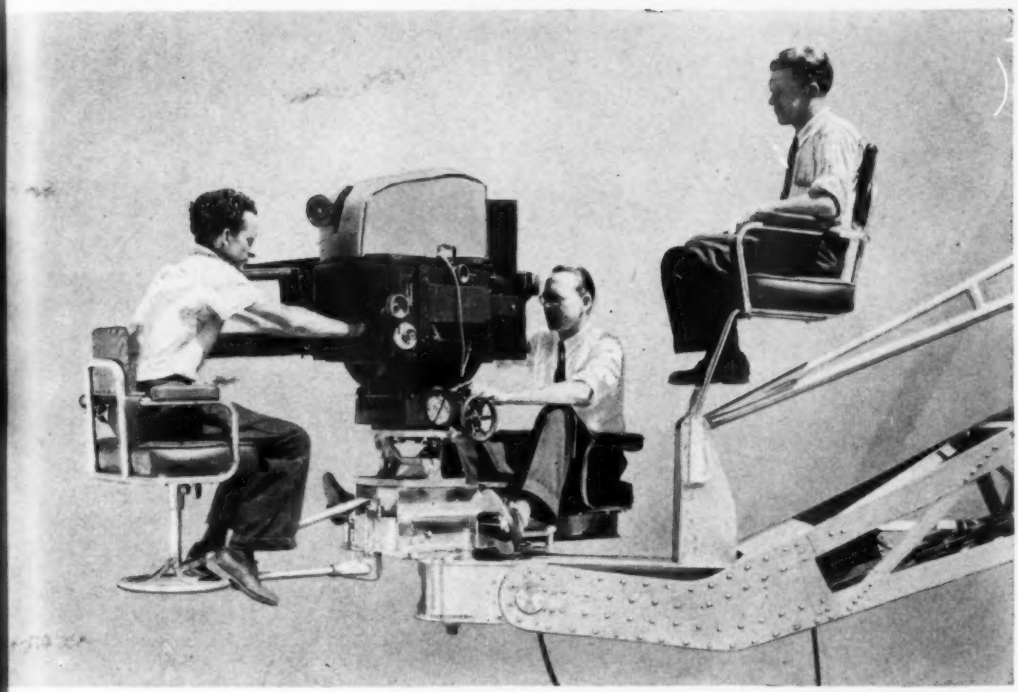
Electric Motors Maneuver Giant Camera Boom

From this turntable boom, cameramen can shoot movie scenes from any angle, as desired

SOARING over props an furniture, following a actor up or down stair whirling around in a com plete circle—these are som of the unusual things that can be do with movie cameras mounted on a ne lightweight camera crane invented b E. H. Heyer and E. L. Fischer, of Holly wood, Calif. Constructed of duralumi and powered by two electric motors, th crane has a turntable base mounted on rubber-tired truck chassis. The came support at the tip of the swinging met boom of the apparatus is so hinged th the camera can remain constantly pointe at its objective, even while it is bein moved forward, backward, sideways, u



Electric motors drive the odd vehicle, which is mounted on sturdy truck wheels. Note the boom's counterweight at the right

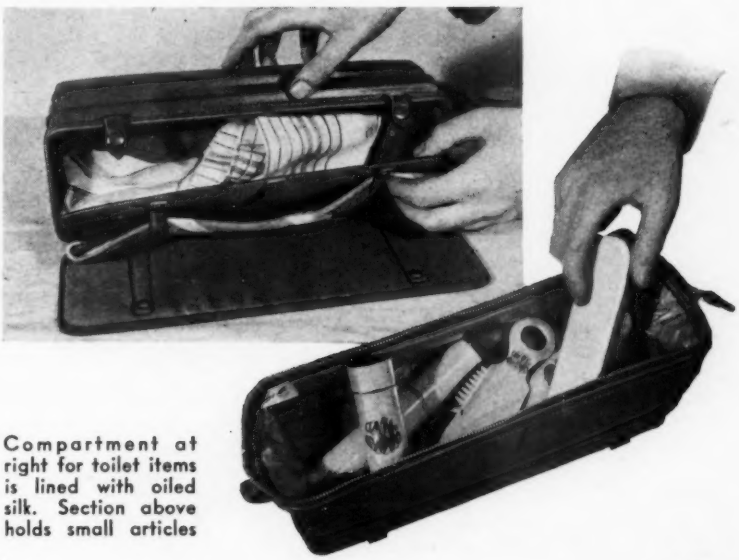


A pivoted chair that can be swung out in front of the camera simplifies the making of lens adjustments

down, thus permitting many new and unusual camera shots to be made. From his perch on the end of the girder boom, the cameraman can control, by means of conveniently situated pedals, every movement of the crane, or it may be controlled automatically by first setting an operating mechanism. A combination drum and pointer needle located near the base of the boom makes a continuous record of the camera's movements so that the operators may repeat the same motions of the camera when retaking a particular scene. The two electric driving motors that power the apparatus can drive it forward or backward at speeds ranging from a snail's pace to twelve miles an hour, while the crane lifts a camera and its operators twenty-five feet in the air.

Traveling Kit Has Space for Ties and Socks

A HANDY kit now on the market for travelers provides not only the conventional compartment for holding comb, brush, toothpaste, and other toilet articles, but also includes a second section, opened by means of snap fasteners, for neckties, collars, socks, and handkerchiefs. The toilet-article compartment has a moisture-proof lining of oiled silk.



Compartment at right for toilet items is lined with oiled silk. Section above holds small articles

Six New Ai

Meter Determines Enlarging Exposure

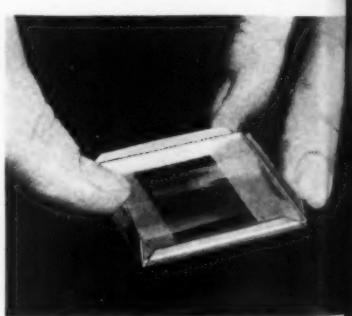
AMATEUR photographers doi their own enlarging now c determine what exposure must used for any given negative means of a compact meter of t extension type. The instrume is placed on the easel which hol the enlarging paper, and lig from the enlarger is projected it through the negative to printed. The meter contains translucent screen of graduat density provided with numbe which correspond to the di phragm-opening numbers on t enlarger. A small amount of lig reaching the meter permits t operator to read the first numbe Increasing amounts of light ma the numbers on the denser po tions of the screen visible. T densest number that can be re indicates the exposure requir for best results in enlarging.

Make-Up Kit for Portrait Sitters

ESPECIALLY designed for amateur camera fans, a new make-up kit contains eleven different items for use in preparing subjects for portrait sittings. Besides powders, creams, and rouge, the box holds a variety of accessories by means of which the make-up can be applied to produce the best effect. A second kit, holding thirteen items, has been put on the market for the use of camera fans who are trying their hand at making natural-color portraits.

The kit contains all the necessary cosmetics for photographic make-up

Soft Metal Frames Aid Slide Makers



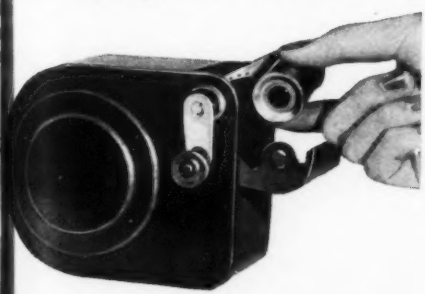
EASILY BENT metal frames f binding black-and-white a color transparencies into slides f use in projection machines a handy accessories. The films a simply placed between two th sheets of glass and the soft met which can be used over and ov is bent around the edge to ho the glass "sandwich" together.

New Aids For Camera Fans

Viewer Notches Negatives Chosen for Enlargement

SIMPLIFYING the work of picking out the best negatives for enlarging from a strip of thirty-five-millimeter miniature-camera film, a new combination viewer and punch is one of the latest additions to the list of equipment available to the owner of a small camera. The device is fitted with a convenient handle for holding the viewer steady while it is in use. The strip of film is passed one frame at a time before a magnifying glass, through which the operator views the negatives. When a frame that is particularly suitable for enlarging is encountered, the operator manipulates a punching mechanism incorporated into the viewer and snips out a small semicircular notch in one side of the film. Later, in the darkroom, the strip of film can be run rapidly through the enlarging machine, stopping only at the notched frames.

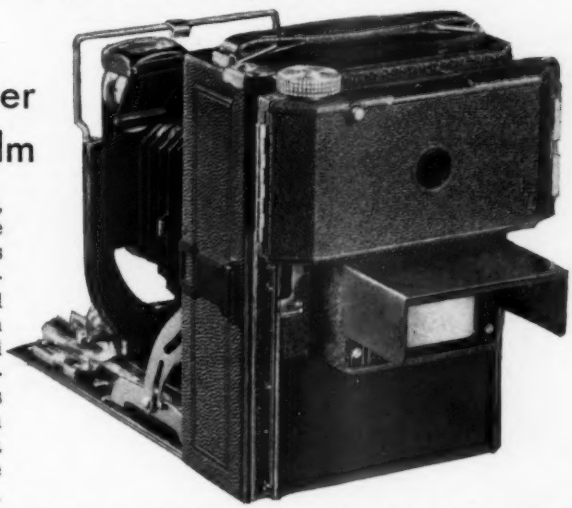
Daylight Loader Feeds Bulk Film into Cartridge



ANOTHER aid for miniature-camera fans is a daylight winder for loading cartridges with thirty-five-millimeter film purchased in bulk. After the bulk film is placed in the mechanism in the darkroom, all other operations can be carried on in full daylight. Another advantage, according to the manufacturer, is that the user can load the cartridges with short lengths of film, to take a few pictures at a time.

Pack-Type-Camera Adapter Uses Small-Size Color Film

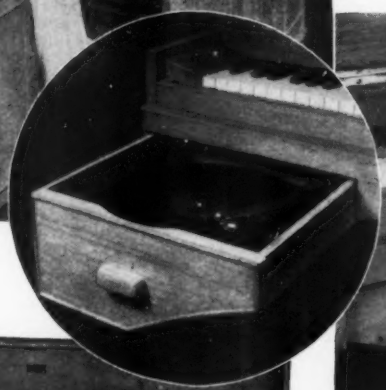
BY MEANS of a newly marketed adapter, cameras which make pictures as large as 3¼" by 4¼" can use small-size rolls of color film. Besides the economy feature, the new arrangement permits critical ground-glass focusing; pictures which take advantage of a long-focus lens; and close-up shots of small objects like insects and flowers. The adapter consists of a film chamber accommodating an eight-exposure roll of color film, and a ground-glass focusing panel. The picture is brought into focus on the ground glass. Then the film chamber is slid into place and the picture taken.



Pictures on miniature-camera color film can be taken with a film-pack camera using this handy new adapter

New Piano Has No Sound Board

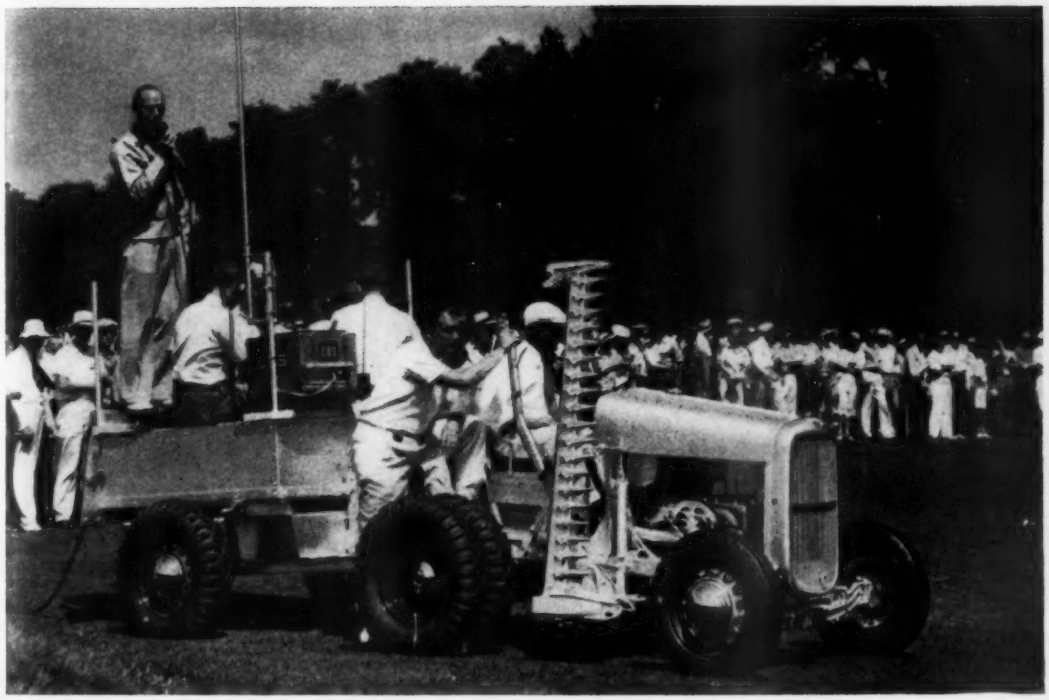
OPERATED electrically, a new small upright piano just introduced has no sound board, yet is said to match the tone, range, and volume of a grand piano. Fitted with the conventional eighty-eight-note keyboard, the instrument employs an amplifier and loudspeaker and a novel pick-up system. Set close to each piano string on an adjustable screw is a small metal disk. Each disk acts as one plate of a variable condenser, the corresponding string serving as the other plate. When a note is struck, the string vibrates, varying the voltage across the gap. Played without amplification, the piano has the soft tones of a harpsichord. A built-in radio and an electric phonograph also utilize the amplifying and loudspeaker system.



Finished attractively, this small piano has the volume and tone of a grand piano

Under one end of the full-length keyboard is a radio; at the other end (inset), is an electric phonograph

The piano is tuned conventionally, while adjustable disks, above, balance each tone's volume. Left, note absence of any sound board



Mower Is Mobile "Studio" for Golf-Match Broadcast

TO FACILITATE their coverage of a recent golf tournament, the crew of a broadcasting chain pressed into service a power-driven golf-course lawn mower. Following golfers over the course from tee to green, the lawn-mower broadcasting truck carried an announcer and his assistant, a technical operating crew, and complete short-wave transmitting equipment for relaying the progress of matches for rebroadcast over a coast-to-coast network. The photograph shows Ted Husing, well-known sports announcer, describing a match.

New Atomizer Is Unbreakable

MADE without glass or moving parts, a new atomizer for spraying the hair with tonics and oils is practically unbreakable, according to its makers. The device, shown in use at the right, has a metal container for the liquid, but is constructed chiefly of rubber, a bulb providing air for the spray. A rubber cap prevents evaporation of the liquid.

All rubber except for its metal container for liquids, this atomizer will not break

Buttons Eject Keys from Case

WHEN a metal projection on a novel, "one-hand" key case is pressed, keys are ejected through the bottom into a position for use. Pressure on a small knob automatically draws the keys back into the case. The eight-key holder comes in a wide variety of leathers.

Synthetic-Resin Coat Makes Paper Washable

COATING paper or cardboard with a waterproof synthetic resin, a machine invented by Bert C. Miller of New York City is said to save as much as seventy-five percent of the cost of manufacturing material for cartons, printing, and other uses. Paper passes across two rollers, one of which heats it to 350 degrees F., while the other applies the resin coating. When applied after printing, the coating provides a protective covering.

Bert C. Miller demonstrating his paper-coating machine. Resin comes in chunks like that held in hand at left, and is melted in the tank shown

The Net Is on the Paddle in This New Ball Game

CATCHING a rubber ball in a net mounted on one side of a paddle is the object of a game introduced recently. The ball is batted back and forth until a player succeeds in trapping it in the net, when two points are scored and the ball is again put into play. A score of twenty-one points wins. The photograph shows a player who has just netted the ball.

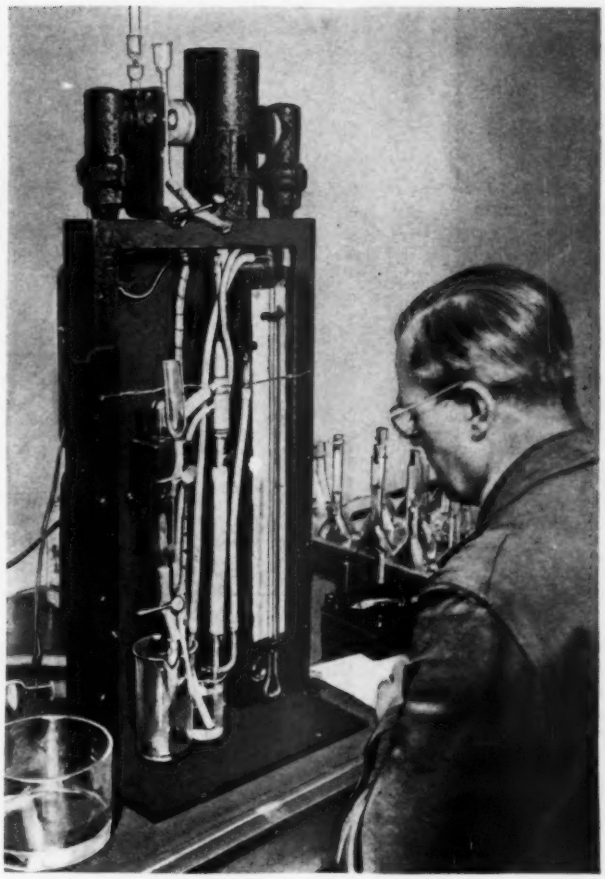
When the tube is squeezed, a fire-snuffing chemical squirts on flames

Squeeze Tube Holds Fire Extinguisher

CARBON tetrachloride, a fire-snuffing chemical, is now packed in an economical metal tube for convenience in fighting small fires. When the cap is removed, the liquid can be squeezed out in the form of a stream that is said to carry for a distance of fifteen feet. If all the chemical is not employed at one time, the cap may be put on and the remainder preserved for possible use in another emergency.

"Fertility Meter" Analyzes Soil

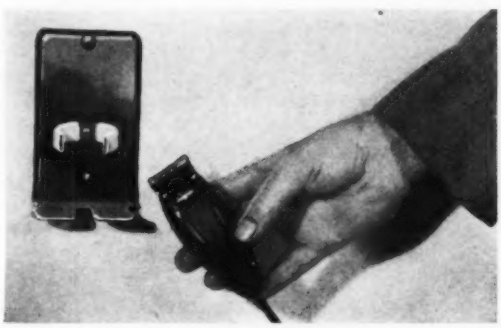
SOIL analysis is made a matter of seconds by an electric "fertility meter" recently developed in Germany. When a sample of soil is placed in the apparatus pictured at the right, a graduated scale shows at a glance whether the soil is acid or alkaline, and indicates its richness in phosphate and other plant-food ingredients. With this information, experts can prescribe the proper kind and amount of fertilizer to be used in the soil tested, to give the best possible crop yield.



This electric apparatus analyzes a sample of soil instantly

New Permanent Ink Writes on Glass

DESIGNED for writing on glass, porcelain, china, and similar surfaces, a new ink is said to give a permanent marking that resists the action of water, acids, alkalies, and strong solvents. Unlike other inks used for similar purposes, it is noncorrossive, and can be kept in ordinary glass bottles. Applied with any steel writing pen, drawing pen, or fine brush, the new ink is expected to prove specially useful for marking chemical glassware and microscope slides.



Rack Holds Electric Razor

A HANDY bathroom accessory for shavers, just placed on the market, is the electric-razor holder shown in the photograph above. Mounted against the wall, the holder has spring clips that clamp the razor securely in place, making it unnecessary to stuff the razor and its cord back into a box and put them away after use.

Rings on Telephone Dial Make It Easier To Use

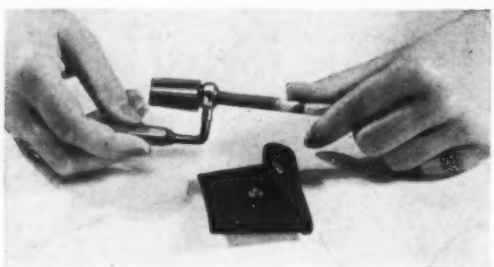
OPERATION of a dial telephone is said to be made easier by the use of a set of metal rings, just made available, which snap into place in the finger holes on the dial. As a call is made, the rings turn with the finger as it revolves the dial. Because the rings turn with the finger, the makers claim, calls can now be made with greater ease and with less danger of breaking a finger nail during the dialing process. Quicker dialing, and less chance of error, are other advantages claimed for the rings, shown being attached.

The inventor puts the finishing touches on a scene painted in colors chosen by the chart

Using the color chart to transpose a sheet of music into its corresponding color tones

Chart Transposes Musical Notes into Colors

WHAT is the color of your favorite piece of music? After several years of research into the relationship of music to color, Dr. Carl Omeron and Archie Vasquez, of Los Angeles, Calif., support the theory that all musical tones have their corresponding colors of the spectrum. To translate a note into its appropriate hue, they use a novel instrument of their own devising called a "color-tono-graph." This is a chart having a movable indicator for rapid transposing of any written note into its individual color. By this means, the experimenters claim, musical selections can be painted as well as played. Soon, they believe, homes may be painted in colors that harmonize with the musical tastes of occupants.

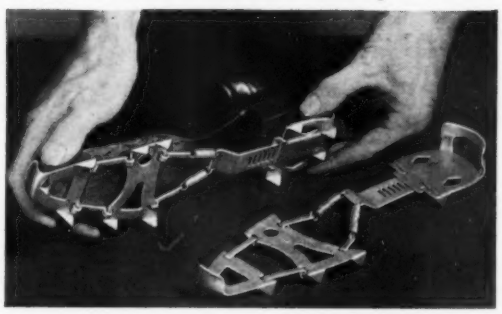


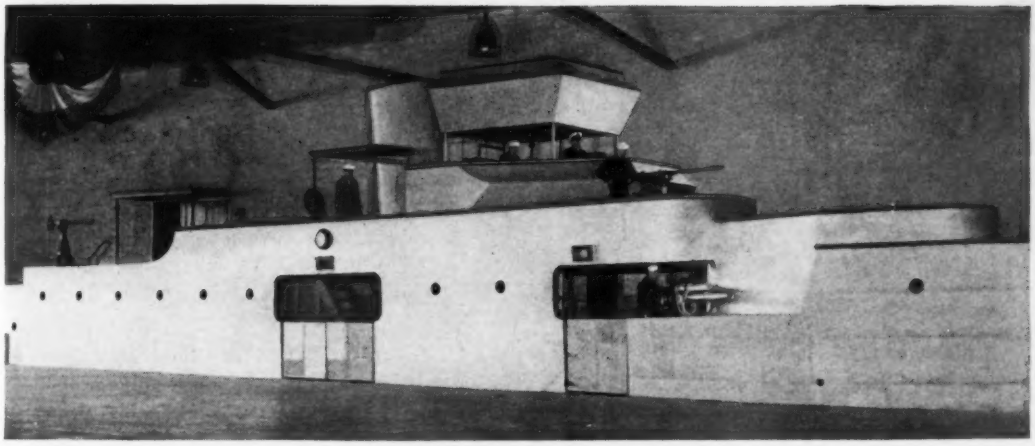
Pocket Pencil Sharpener

PENCILS can be sharpened without soiling your fingers, with a handy vest-pocket machine just marketed. A pencil is pointed by placing it into the sharpening unit, which is then revolved by means of an extension handle, as illustrated in the photograph at the left. The sharpener handle folds up to render the unit compact when not in actual use.

Adjustable Ice Creepers Will Fit Shoes of Any Size

ADJUSTABLE creepers invented by Eugene Farmer, of Elmhurst, N. Y., for walking on slippery ice, will fit on over shoes, rubbers, or galoshes of any standard size. Equipped with triangular spikes on the bottom, the metal creepers have a clamp at one end that clips over the shoe tip, and a saddle at the other end that clings snugly to the heel. Springs keep the ice walkers tight to the shoe, while a locking device just forward of the heel plate permits the user to adjust them easily for the length desired.





Indoor Man-of-War Trains Sailors

A WARSHIP that will never be launched into the water has just been completed at the Naval Armory in Detroit, Mich. Measuring 131 feet long, the indoor man-of-war was built for the purpose of training 600 Naval Reserve officers in the fine points of warship construction and operation. The $50,000 land vessel has the hull of a cruiser, the bridge of a battleship, and the guns of a destroyer. The dry-land warship is seen in the photo above.

Self-powdering powder puff and case. Below, filling the reservoir

New Magazine Powder Puff

A POWDER puff now available has its own built-in powder container. In use, the powder sifts through the puff fabric as the puff is dabbed over the skin. The powder reservoir is refilled through a rotating metal top, as illustrated above.

Snake Venom Soothes Eyes

DEADLY rattlesnake and cobra venom is being used to relieve pain in diseases of the eye. The venom also is employed to stop bleeding during eye operations, and for treatment of trachoma and cancer of the eye.

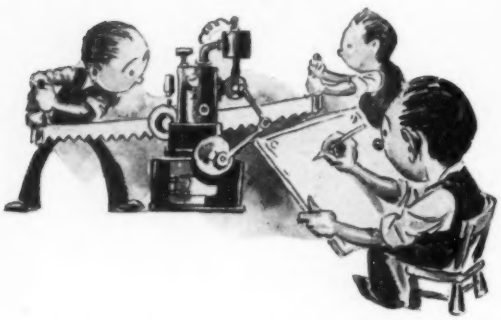
Violet Rays Replace Rouge

AN ELECTRICALLY operated rouging machine recently introduced for beauty-shop use has a Y-shaped glass tube that emits violet rays that are said to stimulate blood circulation in the cheeks and produce a natural red color.

Rays from the Y-shaped tube bring color to cheeks

POPULAR SCIENCE *Question Bee*

Do you know your way around in the world of science and mechanics? Try to pick out the correct statement in each of the paragraphs below. Note the corresponding letter and check on page 240



1 A drawing showing a machine apparently sliced in two is called a *(a)* midsection *(b)* cross section *(c)* conic section *(d)* Caesarean section.

2 Camera lenses of high optical quality are known as *(a)* bifocals *(b)* anastigmats *(c)* optical flats *(d)* heliostats *(e)* oil-immersion objectives.

3 The hardest known substance is *(a)* tungsten *(b)* fused quartz *(c)* the diamond *(d)* duralumin.

4 One thousand grams make *(a)* a kilogram *(b)* a milligram *(c)* an anagram *(d)* a cryptogram.

5 Microscopists use a transparent cement sold under the name of *(a)* balm of Gilead *(b)* Canada balsam *(c)* French brier *(d)* Peruvian bark.

6 When placed in an acid, a strip of litmus paper is colored *(a)* brown *(b)* blue *(c)* red *(d)* green *(e)* yellow.

7 If one cylinder of your car appears to be misfiring, you should *(a)* ride the clutch *(b)* check the ignition *(c)* retard the spark *(d)* blow a cylinder head.

8 Electrical insulators belong to a class of substances called *(a)* dielectrics *(b)* electrolytes *(c)* eutectics *(d)* vesicants.

9 A piece of metal built up out of a number of thin sheets is called *(a)* articulated *(b)* striated *(c)* laminated *(d)* prefabricated *(e)* matriculated.

10 The distance between a car's front and rear axles is its *(a)* focal length *(b)* wheelbase *(c)* camber *(d)* turning radius.

11 Sodium vapor is now being utilized successfully in *(a)* dirigibles *(b)* electric lamps *(c)* bottled gas for country homes *(d)* anesthesia.

12 Machine parts may vary from specified dimensions by an amount called the *(a)* tolerance *(b)* easement *(c)* roughage *(d)* plethora.

13 A chemist uses the abbreviation "ppt." for *(a)* a pipette *(b)* a phosphate *(c)* a precipitate *(d)* phenolphthalein.

14 Tetraethyl lead is used in *(a)* dental fillings *(b)* antiknock gasoline *(c)* smokeless powder *(d)* colored pencils.

15 A common mechanical device to keep a wheel or shaft from turning the wrong way is called a *(a)* cam *(b)* bell crank *(c)* ratchet *(d)* gasket.

16 Parts of a small organism are often differentiated more clearly under the microscope by *(a)* gilding it *(b)* staining it *(c)* boiling it *(d)* etching it with strong acid.

17 You could demonstrate the rotation of the earth with a *(a)* Cartesian diver *(b)* manometric flame *(c)* Foucault pendulum *(d)* Torricellian vacuum.

18 Amber is *(a)* a natural by-product of the growth of coral *(b)* a mineral deposited in veins by underground waters *(c)* a fossil resin from prehistoric trees *(d)* a substance secreted by sick whales.

19 Entomologists study *(a)* fish *(b)* insects *(c)* trees *(d)* climate.

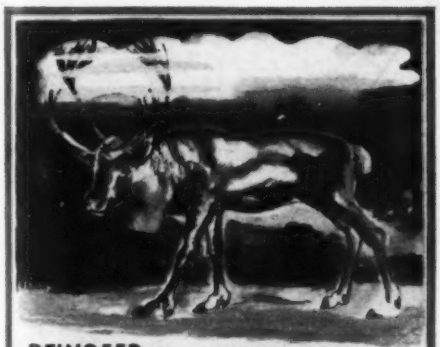
20 A development of great social significance to a large part of the country is foreseen in the introduction, by the Rust brothers, of a machine to *(a)* pick cotton mechanically *(b)* convert water into a fuel for automobiles *(c)* detect when people are telling lies *(d)* calculate the value of pi to forty-seven decimal places.

Un-Natural History

By GUS MAGER

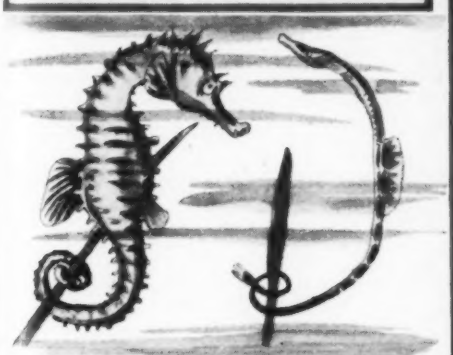
ONE OF THE **DIGGER WASPS** HAS ASTONISHED ENTOMOLOGISTS BY USING A TOOL— A PEBBLE HELD IN THE MOUTH TO POUND DOWN THE EARTH OVER HER BURROW!

MANY BIRDS DO COURTSHIP DANCES! **CRANES,** FOR EXAMPLE, PUT ON AN ACT COMBINING STEPS RANGING FROM THE CAKEWALK TO THE SHAG! TALK ABOUT JITTERBUGS!



REINDEER ARE ALWAYS COVERED BY A BLANKET OF WHITE CLOUD DURING THE MIGRATING SEASON! IT IS A MIST FORMED BY EVAPORATION OF MOISTURE EXUDING FROM THE SKIN!

ALTHOUGH **FLAMINGOS** HAIL FROM SUBTROPICAL REGIONS, THEY CAN STAND THE COLD AS WELL AS ANYBODY! HOWEVER, IN ZOOS THEY ARE KEPT INDOORS IN WINTER SO THEY WON'T FREEZE FAST IN THEIR POOLS!

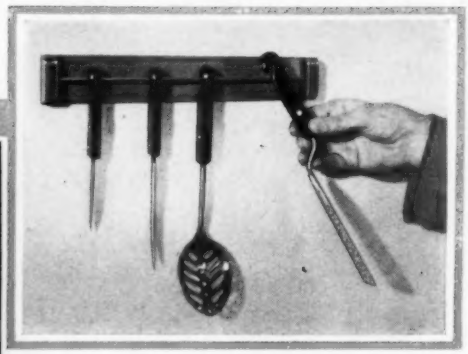


THE **SEA HORSE** AND A COUSIN, THE **PIPE FISH,** ARE THE ONLY FISHES SPORTING MONKEYLIKE GRASPING TAILS!

HUNTERS AND ZOO KEEPERS SAY THAT **LIONS, TIGERS,** AND OTHER LARGE MEMBERS OF THE CAT FAMILY ALWAYS ATTACK BLACK MEN IN PREFERENCE TO WHITE! EVEN COMPARATIVELY TAME BEASTS GET EXCITED WHEN A NEGRO COMES AROUND!

Latest Conveniences

FIVE-QUART MIXER. Food can be mixed and prepared in large quantities in the home by the use of a new type of mixer with a capacity of five quarts. The powerful motor is housed in the boxlike supporting stand seen in the photograph



WALL RACK FOR KITCHEN TOOLS

Eight cooking necessities, including several knives, are supplied with this handy wall rack. A notch in the handle of each tool enables it to be hung on the crossbar

SERVER KEEPS FOOD FRESH

A humidifier built into the cover of this serving tray prevents sandwiches, cakes, and other baked foods from drying out. A spoonful of water moistens the humidifier

MERRY-GO-ROUND TRAY. Concocting beverages is a lot of fun with the novel tray at the left. Glasses rest on a roller-bearing chromium turntable which revolves to bring them in turn under a spout through which measured amounts of liquid are pumped from a decanter

for the Household

TABLE WARMING OVEN. More than two feet long, the electric warming oven at the right will hold dozens of rolls, biscuits, or pop-overs. It also is large enough to take two dozen plates or two large dishes of hot food

HEATS BABY'S FOOD. In addition to heating a baby's bottle to the right temperature and then shutting itself off automatically, the electric device below has a porringer for heating solid foods and a vaporizer for use in treating colds. The vaporizer is seen in the inset below

COFFEEPOT HAS OVERCOAT. Coffee is kept piping hot for hours in a new coffeepot that fits into a chromium-plated insulating shell. A dripless spout is another special feature

TOY BOAT TESTS BATH

Made in the shape of a boat, the floating bath thermometer illustrated above is sure to appeal to children. For further realism, a stick can be inserted in a hole at the bow, and a paper sail attached

The report made Joe Clark, who was looking over some repair-job slips, jump a foot

GUS SOLVES

Queer Gas-Line Troubles

By MARTIN BUNN

BANG! The sharp report made Joe Clark, who was looking over some repair-job slips at Gus Wilson's workbench, jump a foot.

Gus laughed. "You looked just like a man getting stung by a superpowered wasp," he told his partner in the thriving little Model Garage.

Joe grinned back at him. "Sounded like a blow-out," he said, wiping a clear spot on the misted window pane and peering out into the rain that was coming down in sheets. "That's funny—there's not a car in sight. That driver must have gone right ahead on the flat. Well, that means that some one will be selling him a new tire." Suddenly he looked anxious. "Hey, Gus—that noise sounded as if it was right here in the garage. I wonder—"

"Now, don't go and get yourself all steamed up," Gus said. "That noise *was* right here in the garage, and it *was* a blow-out." He pointed at the right rear wheel of a car that was in for a check-up. Its tire was flatter than a day-before-pay-day bill fold. "There's the baby that made you jump."

"That's a new one on me," Joe said. "First time I ever heard of a tire blowing out while a car was standing in the shop."

"It doesn't happen so very often," Gus admitted. "When it does, it's the result of a bad stone bruise."

"Huh?" Joe asked.

"You're driving along pretty lively—maybe at fifty-five or sixty an hour," Gus explained. "One of your tires hits a stone. Perhaps you don't even notice it—and if you do notice it, and get out and take a look at your rubber, everything seems all right. The tread of the tire that hit the stone isn't damaged, and you can't see that the inside layer of its fabric is broken. Well, the inner tube works into the break in the fabric, the unbroken layers of fabric can't sustain the air pressure, and your tire blows—maybe hours or maybe even a couple of days after the tire got the stone bruise. See?"

"Sure, I see," Joe said. "Well, Gus, since you're so good at riddles, how about answering this one? While Mrs. Sherman was in buying a new lighter yesterday, she said that her car always runs better—the engine runs smoother—at night than it does in the daytime. She wanted to know how come. I didn't know, but I told her I'd ask you about it."

"That's a cinch," Gus assured him. "There are two reasons. One of them is that the air is cooler and heavier at night. That results in a greater *weight* of air being admitted to the cylinders at each stroke. The greater the weight of air and fuel vapor that is admitted, the more power the engine develops.

"The other reason is that at night the air usually has more moisture in it than it has during the day. The increased moisture slows down combustion. Slower combustion results in lessened detonation—and so, of course, in

increased smoothness of the car's operation."

He waved a monkey wrench menacingly at his partner. "Hey, is this a quiz party?" he demanded. "You ought to have better sense than to get me started talking about gas engines early in the morning. Scram! I've got work to do. Say, where the heck is Harry? That darned grease monkey never is around when—"

"I sent him out with the wrecker," Joe said. "Ez Zacharias—you know him, the R.F.D. carrier—phoned and said he'd have to be towed in. He's got a new car, and he's stalled over on that dirt road back of Mechanicsville."

Half an hour later Harry drove up in the wrecker and towed a shiny new sedan, liberally splashed with mud, into the shop. Ez Zacharias, a big-chested citizen with a weather-darkened face and a postman's cap on the back of his head, climbed out of the towed car.

"By gum!" he said, "I'm mad right down to the soles of my shoes! That old car of mine that I turned in to get this pesky contraption had eighty-nine thousand on her, and she creaked in every joint, but I wish I had her back!"

Gus grinned at him. "Maybe you drove that old wreck so long you forgot how to drive a real automobile," he suggested teasingly. "But what's the trouble, Ez?"

Zacharias pursed his lips and let fly a successful testing shot at the waste box under the workbench. Then he bit a fresh half-inch chew off the end of a stick of black plug. "Trouble enough," he said. "There's something all wrong with the gas line on this here job, and I can't for the life of me find out what it is. It's been givin' me the devil, and my mail's late, and every one on my route is threatenin' to write to Jim Farley and get me fired. Maybe they think *he* could get this car runnin'!

"I bought her a month ago. For a couple of weeks she ran like a—like a dream. Then that wet spell come along. The first day of it, I went over the route easy as slidin' off a log, and I said to myself: 'Ez, you were pretty smart gettin' this new car before the real bad weather set in.' And then, by gosh, the very next mornin' she wouldn't start!

"Well, sir, I fooled around and fooled around, tryin' first one thing and then another, and after a while I got around to the carburetor and found that the sediment bowl was jest one solid chunk of ice. And the gas pipe wasn't any better! So I thawed 'em out, and drained the gas tank, and filled it up again. I'd bought some gas off a feller out

A big-chested man with a postman's cap on the back of his head climbed out of the towed car. "By gum," he said. "I'm mad down to the soles of my shoes."

$100 in Prizes
FOR GARAGE MECHANICS

If you make your living repairing and servicing automobiles, Gus Wilson, Joe Clark, and Martin Bunn would like to hear about the queerest job that you ever tackled and licked. For the most interesting letter of not more than 500 words telling about a mysterious car ailment and the way it was cured, we will pay $50. The second-best letter will win $25, and the writers of the five next-best letters will get $5 each.

Any garage owner or mechanic can enter the contest. Employees of POPULAR SCIENCE MONTHLY and their families are excluded. The judges will be Gus Wilson and the technical editors of this magazine, and their decision will be final. In case of a tie, each tying contestant will be awarded the prize tied for.

Address your letters to Gus Wilson, in care of POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y., and be sure to mail them before midnight on January 15, 1939, the date when the contest closes. No entries will be returned, and all entries become the property of POPULAR SCIENCE MONTHLY.

in the country the day before, and I figured he'd been careless and given me plenty of water along with it.

"She ran all right for a week after that. Then we had another rainy day, and a right cold night after it. Next mornin'—same darned thing! Sediment bowl and gas line froze solid. After I got her goin', I took her over to the feller I'd bought her from. He went all over everything, and looked wise, and told me that I wouldn't have any more trouble.

"And I didn't—not until this mornin'. She started all right, and ran all right until I got over in those hills back of Mechanicsville. Then the motor began to slow down and miss, and I had to give her the choke to keep it runnin'. When I got to Griggs's store I got out and took a look, and found the sediment bowl full of muddy water. I cleaned it out, and got goin' again. Quarter of a mile farther along—same thing all over again. It was pourin' cats and dogs, but I says: 'Ez, if there's any one who can find out what's wrong with this danged car, it's Gus Wilson.' So I walked to the nearest house with a 'phone, and rung you up. Now *you* fix her!"

And Zacharias rang the bell with another long-range shot at the waste box.

Gus grinned. "Thanks for the bouquet, Ez," he said. "Now let's see if I can earn it." He tipped his cap over his left eye as he scratched his head thoughtfully.

"Better take a look at her innards," Ez suggested.

Gus shook his head. "No use in that," he said. "You found water—or ice—in the sediment bowl three different times. That proves that somehow water must have got into your gasoline. Well, that happens often enough, one way or another. But you said that it was *muddy* water. Sure of that, Ez?"

"Sure as death and taxes," Zacharias insisted. "That water was as muddy as the bottom of Mud Lake. And when it was froze, you could see the mud in the ice."

"Well," Gus said, thinking out loud, "there's just one way in which *muddy* water could get into the gas line—through the filler pipe." He stooped down, and peered under the rear fender. Then he laughed. "Here it is, Ez," he said, "and it's a brand-new one on me!"

Zacharias stooped down and peered under the fender. "See that hose that connects the filler pipe and the gas tank?" Gus asked. "See that clamp that holds it snug on the gas tank?"

"Sure, I see it," said Zacharias.

"But you don't see a clamp like it holding it snug to the filler pipe, do you? There isn't any. But there should be one. It never was put on, or it's jarred loose and fallen off. Either way, the vibration of the filler pipe has spread the upper end of the hose until it looks like a funnel. Driving on those dirt roads in wet weather, your rear wheels threw a lot of mud and water up inside the fender. Some of it ran down the filler pipe, and dripped into that funnel, and then ran into your gas tank. It'll take me five minutes to put on a clamp, and maybe another ten to drain your tank and carburetor. And then you can get back on your job, and keep out of Jim Farley's black books."

Zacharias straightened up with a grunt, and scored another plopping bullseye on the waste box. "I'll be derned!" was all he said.

An hour or so later, Joe came into the shop. "Saw old Ez driving away with a grin that stretched from one ear to the other," he said. "Nothing much wrong with his car, I suppose?"

Gus told him about it.

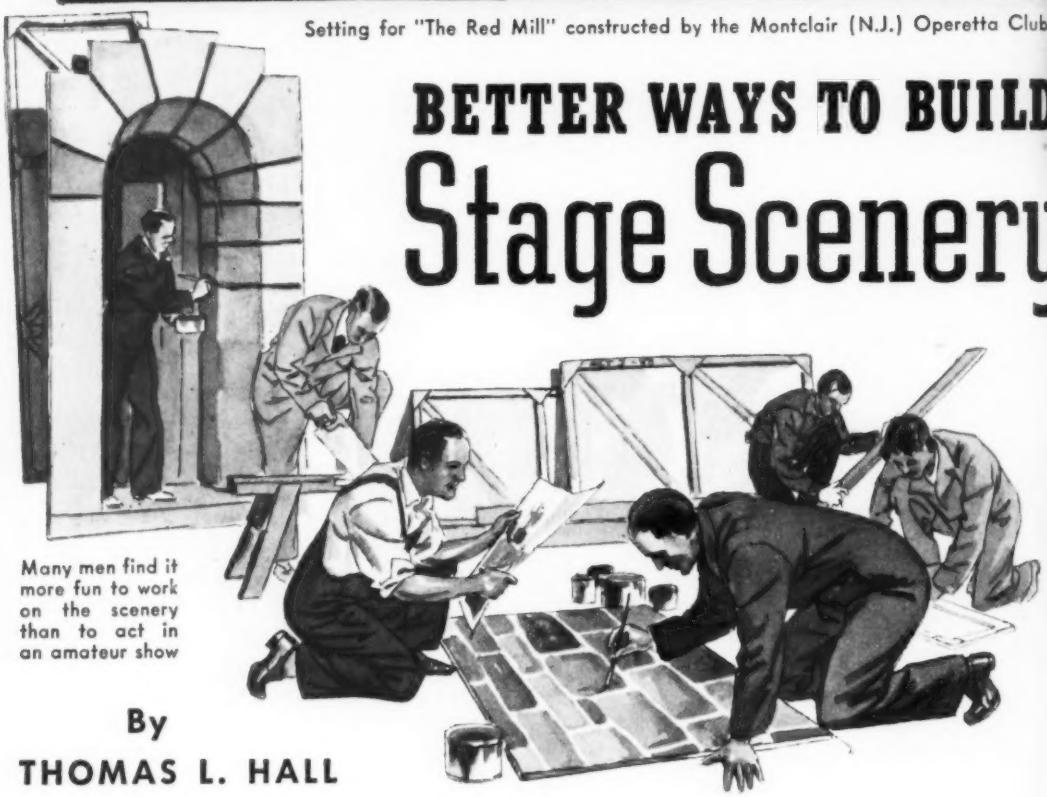
"We get quite a few of those gas-line jobs, don't we?" Joe remarked. "None of them amount to much, though."

"They don't amount to much from *our* angle," Gus said, "but they often make a lot of grief for drivers. Most fellows, when their engines don't run *(Continued on page 238)*

THE HOME WORKSHOP
In This Issue..
Superdreadnoughts in Miniature
Lazy Man's Radio Tuner
Amateur Stage Scenery
Speedy Motor Sled

Setting for "The Red Mill" constructed by the Montclair (N.J.) Operetta Club

BETTER WAYS TO BUILD Stage Scenery



Many men find it more fun to work on the scenery than to act in an amateur show

By
THOMAS L. HALL

WHEN amateur theatricals get under way, the average craftsman often feels more at home constructing a set than acting in front of one. So much more fun is to be found behind the scenes that the building of scenery can become his major interest. Specific rules for erecting stage sets cannot, of course, be given, but the methods outlined here have been used successfully by the Montclair (N.J.) Operetta Club—a group supported by a highly critical patronage accustomed to the perfection of Broadway productions.

As soon as the play has been chosen, the scenery designer prepares his preliminary plans and checks them carefully with the coach, stage manager, and scenery builder. Every effort is made to have the designs in their final form by the time the play goes into rehearsal, and no major changes are tolerated once the construction work is started.

Miniature stage with design for a set worked out in cardboard

How flats are made, covered and painted . . . Doorways and arches . . . Trees and rocks

•

A model stage scaled 1″ equals 1′ is useful in planning the set. When the design is in shape, dimensioned sketches are made of each part, the floor plan drawn, and the model set up. The scenery is cut from cardboard and colored with crayon.

Most scenery consists of flats with various modifications. For amateur work the flats should be inexpensive but durable enough to be used many times. Determine one or two sizes and adhere to them as closely as possible. Widths 5′ and 6′ are good; the height is determined by the size and trim of the stage and the shape of the auditorium. Use grade D select Idaho pine ⅞″ by 3⅝″ (1 by 4's) dressed four sides. The average run of a pile usually

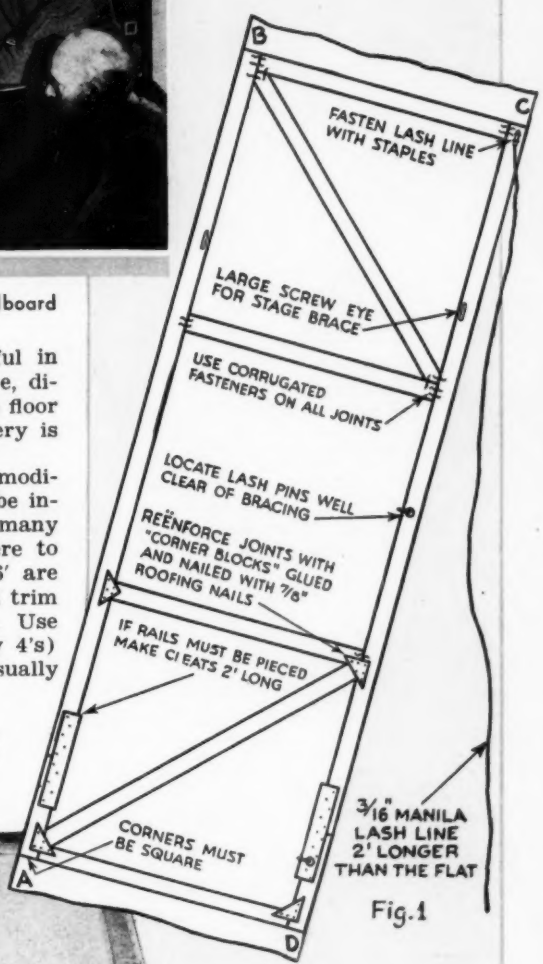
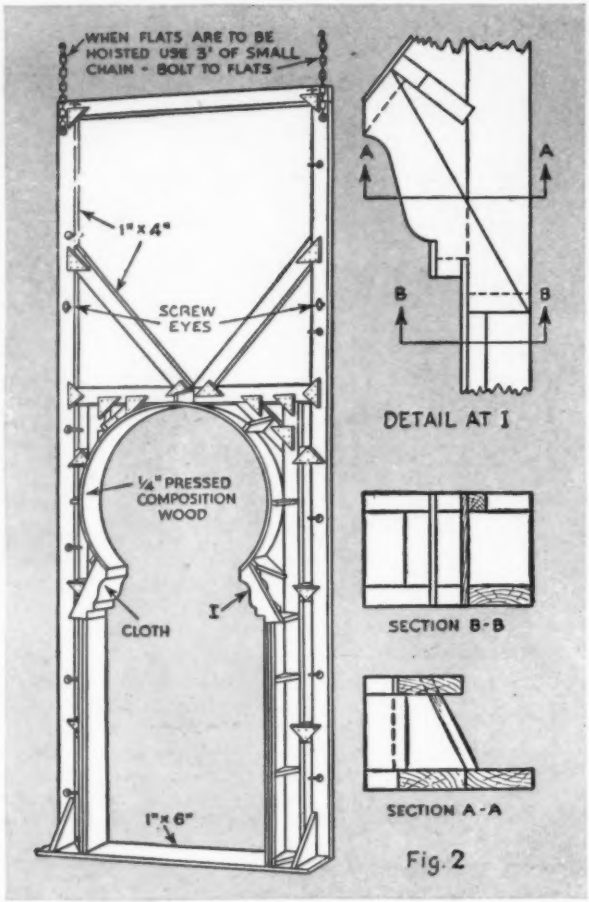

B
C
FASTEN LASH LINE WITH STAPLES
LARGE SCREW EYE FOR STAGE BRACE
USE CORRUGATED FASTENERS ON ALL JOINTS
LOCATE LASH PINS WELL CLEAR OF BRACING
REËNFORCE JOINTS WITH "CORNER BLOCKS" GLUED AND NAILED WITH ⅞" ROOFING NAILS
IF RAILS MUST BE PIECED MAKE CLEATS 2' LONG
3/16" MANILA LASH LINE 2' LONGER THAN THE FLAT
CORNERS MUST BE SQUARE
A
D

Fig. 1

Scenery consists mainly of frames or flats made and covered as in the diagram above. In use, they are lashed edge to edge

Covering a new profile which has been added to an old flat



Rear view and details of a flat containing a Moorish arch. Note how simply the effect of thickness has been obtained

furnishes enough straight pieces for the side rails. Warped pieces can be used for ends and cross braces. The method of constructing the flat frames and covering with cloth is shown in Fig. 1.

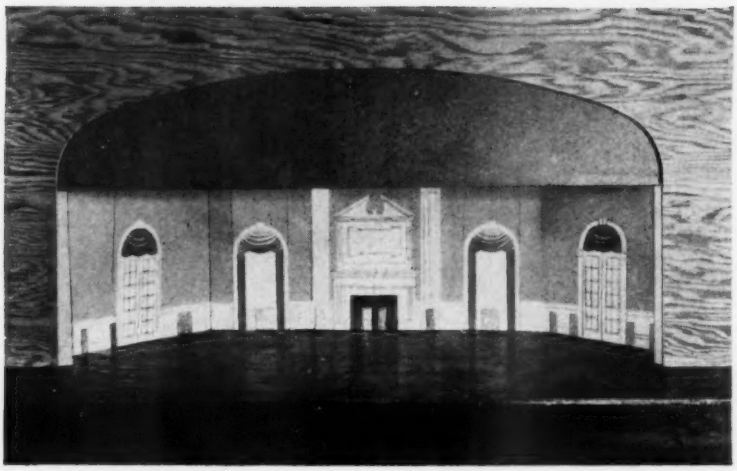
Have your lumber dealer cut up a 4′ by 8′ sheet of ¼″ three-ply fir veneer into right triangles 6″ on a side. The result is 256 good corner blocks for about $4 as compared with $10 for the professional variety. Buy professional lash pins: making substitutes is not worth while. Big screw eyes are good enough to hold the stage braces. Turn the eyes vertical, and don't let the points stick through the flats. Any kind of molding to hide the joints between flats is useless—the audience never sees the cracks. A badly warped rail can be pulled into place with a wooden hand screw or glue clamp when on stage.

Ordinary unbleached muslin sheeting is fine for covering the flats. Spread the cloth on the floor and place frame on top. Fold the selvage edge of the material over the edge of the frame along AB (Fig. 1) so the threads run square with the flat. Tack the cloth to the back of the frame at *A*, then pull tight and tack at *B*. Complete tacking along *AB*. Now pull straight across and tack at *C*. Continue along *CD*, pulling down as well as across. Cut off the surplus and tack the ends, pulling out wrinkles and turning in corners.

Used flats may be cleaned with a mild solution of trisodium-phosphate and a lot of elbow grease. Rubber gloves are advisable for this process. Pour a pint of solution on the flat and rub well with a sponge. Always dry flats in a vertical plane. Patch any holes in the covering by gluing a small piece of muslin on the outside; then brush thin glue over the patch.

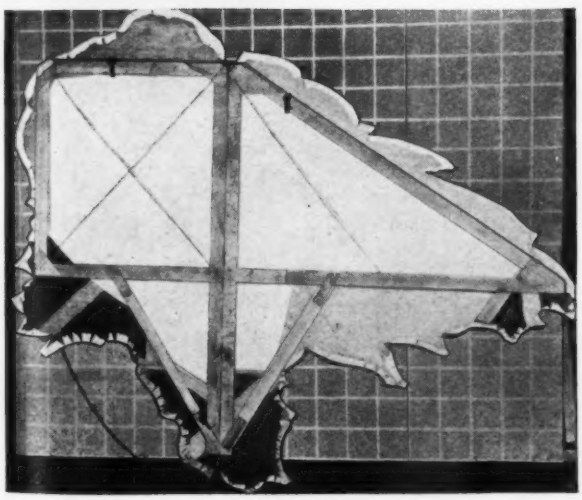
After the flats are finished, size them to stretch the cloth and to form a base for the paint. Make the size by mixing 3 lb. of whiting with a bucket of hot water which contains enough dissolved glue to be tacky between the fingers. The size may be neutral or tinted to form the base color of the paint. Slop it on with a 6″ brush, but don't let it dry in puddles. The size is also the base of scenery paint. Dry ground colors are simply mixed into it. Making the colors is something that cannot be taught or described—you'll have to

How a muslin covering is applied to an arch made from pressed composition wood so it may be painted more easily



Scale model of a set for the "New Moon." The parts are cut from cardboard and colored with crayons

Left, a tree of this type may be used many times. Below, rear view of tree top to be hung in front of a tree trunk



experiment. For small work or where an intense black is required, show-card colors may be used. These, however, will not stretch cloth if applied alone. Aniline dyes are used for back drops and other "soft" scenery because they have no tendency to stiffen the cloth. *Never* use oil paint.

It is not uncommon to use 20 lb. of glue in building a three-act set. Always buy the flake variety as it seems to dissolve more easily than ground glue. Prepare it in an ordinary double boiler. Fill the top section with glue, cover with cold water, and let stand overnight before using. Apply both glue and paint while hot. If you use a gas or kerosene stove, a great deal of grief can be saved by standing the double boiler on an ordinary pie tin when heating. In case the water boils over, it will not put out the flame.

Never attempt to make practical door or window frames integral with a flat because the result is always heavy and cumbersome. Frame the opening with 1 by 4's, allowing plenty of clearance all around, and insert the frames, Large openings such as arches require a reveal; that is, a piece around the opening perpendicular to the plane of the flat to give an illusion of thickness. Thin pressed composition wood is strong enough for this purpose and can be bent to almost any curve. For short bends, wet the rough side thoroughly, placing it on the outside of the curve.

A Moorish arch, which has a complicated reveal, is shown in Fig. 2. Note the use of triangular blocks to support the reveal. They should be screwed fast to the framing. Spring the curved reveal into place and nail it to both the frame and the supports. The intricate curve at *I* is supported by blocks, and the cloth is stretched tight over the curve with the warp running straight up and down. The result is a surface corresponding to the sawed curves. The tread at the bottom should be as wide as the reveal. Don't attempt to make a heavy arch without a bottom piece. This entire arch structure can easily be knocked out of the flat without damage and used elsewhere if

desired. The pressed composition wood used for reveals will not take paint and must be covered with cloth, as shown in one of the photographs. Give the board a coating of thin glue and smooth the cloth over it, brushing out the wrinkles with more glue on a brush. Glue a strip over the turned-up flaps on the curves to cover the bare spots; then paint as usual.

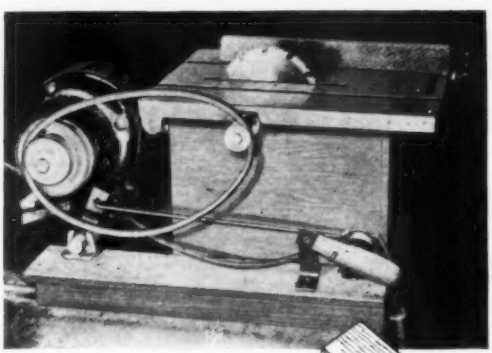
Sometimes it is necessary to construct an arch flat with no bottom. In this case, after the flat is built and covered, another 1 by 4 should be nailed along the back of each rail so as to project about 1″ on the outside. This forms a rabbet into which the adjoining flats will fit and thus provides considerable stiffening. Always nail a temporary piece across the bottom of an open arch when not in use.

Profiles or outlines representing rocks, trees, and the like are best cut from pressed composition board and glued and nailed to the flats before covering. Fasten the cloth to the straight part of the flat first and then glue fast to the profile, turning little flaps over the edge and gluing them to the back, as shown in one of the photographs. Rock and tree profiles can be standardized and reused many times with different painting. Three-dimensional rocks are seldom necessary except as property pieces to sit on. They can be concocted from scraps of lumber and some chicken wire. Cover with cloth stuffed out with newspapers. The sloppier this kind of a job is, the better it looks.

Next month Mr. Hall will give simple ways to make windows, platforms, odd-shaped pieces, and other stage accessories.

Motor Started Without Load to Avoid Blowing Fuses

WHEN started under load, home workshop motors that are plugged into lighting circuits sometimes blow fuses because of the heavy current drawn in starting. This can be avoided by allowing the motor to run idle when it first starts. One way to do this is to mount the motor on a "floating" rail so it can be tilted forward by pulling a handle as shown. Raising the handle allows the motor to drop back against the belt.



To start, the handle is pulled forward. It is then raised as shown below

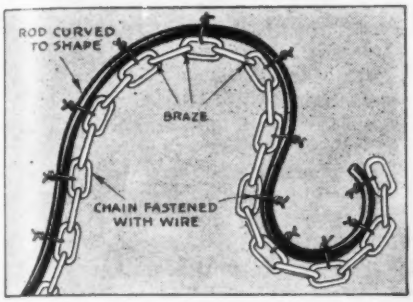
A bracket is bolted to the rail of the motor mounting and connected to the handle by a rod. The handle pivot is placed about 3″ above the bench so that when the handle is down, the weight of the motor will keep it in this position. As an additional convenience, the motor is connected through a toggle switch mounted beside the handle, where it can be flipped on with one finger when the handle is lifted.—MERLE TERRILL.

Nails Pulled from Back of Finished Moldings

IF QUARTER-ROUND base molding, window stops, or other finished woodwork has to be removed and replaced, amateur woodworkers often attempt to drive the nails out, with the result that the puttied nailheads split out large chips. A carpenter avoids this difficulty by pulling the nails through from the back with pincers.—DONALD R. FOSLER.

Mystic Chain Lamp

AND SMOKING STAND



For curved shapes, a jig is made and the chain wired to it so that the links may be brazed together

MADE from ordinary iron chain, a floor lamp, smoking stand, or other novelties of the type illustrated always arouse curiosity. The secret of making the chain stand up is to braze each of the links carefully.

The chain must be thoroughly cleaned with steel wool or by dipping it in a dilute solution of hydrochloric or sulphuric acid. A crude form or jig is then made to hold the chain in the desired shape. If a straight piece is required, one end may be put in the bench vise and the other end held out taut by fastening a wire to it and tying the wire securely to some solid support. For curved parts, a jig may be made by bending pipe or rod to the desired shape.

Although an acetylene welding torch is desirable, the brazing can be done with a good gasoline blowtorch. Place sheet asbestos around the link to be brazed, and apply a liberal amount of borax-and-water paste as a flux. After heating for a minute or two, place small scraps or filings of brass on the link. When the chain and brass reach the proper temperature, the brass will flow into the link. The joint then may be allowed to cool. It may be desirable in some cases to build up the joint by flowing in additional brass.

Where the legs of the floor lamp meet the upright chain, a solid iron piece is used. The end links are cut in the middle, fitted into holes drilled in the iron, and brazed. The base and ash-tray support for the smoking stand are turned from wood, and parts of swivel joints

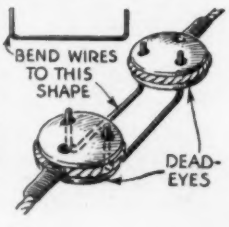
The chain stands up as if by magic. Left, how the straight pieces are brazed

are used as connections at the top and bottom.

The projects illustrated were finished in gold paint. If preferred, they might be painted black and then silver or gold powder blown on at various places before the paint begins to dry.—PERRY HYAMS and C. C. COOLEY.

Lining Up Model Deadeyes

SHIP-MODEL deadeyes may be lined up more easily in order to start threading the lanyards through their holes if two wires are bent as shown to hold them the correct distance apart. The bent-over ends are pushed into the deadeye holes and removed as the lanyard replaces them. —S. P. ROBBINS.



PLANS FOR CONSTRUCTING A

Pegged-Joint Bed

Is your hobby building furniture? Then why don't you let us see some of your work. Pick out the most attractive, novel, and useful piece you have made recently and prepare an article about it similar to this one. If it proves suitable for publication and the illustrations are good enough, you will be paid for it immediately.

IN STYLE, I call this bed "modern Colonial"—modern because of its smooth lines and purely structural use of materials, and Colonial because of its simple design, straightforward craftsmanship, and pegged joints. It takes springs of the standard double-bed width. If springs of another size are used, change the dimensions to suit.

The wood to be used is largely a matter of choice. For a natural finish, maple is, of course, ideal. If an enamel finish is to be used, birch takes paint well and has the advantage of being strong and hard, but a softer wood such as whitewood is also quite satisfactory.

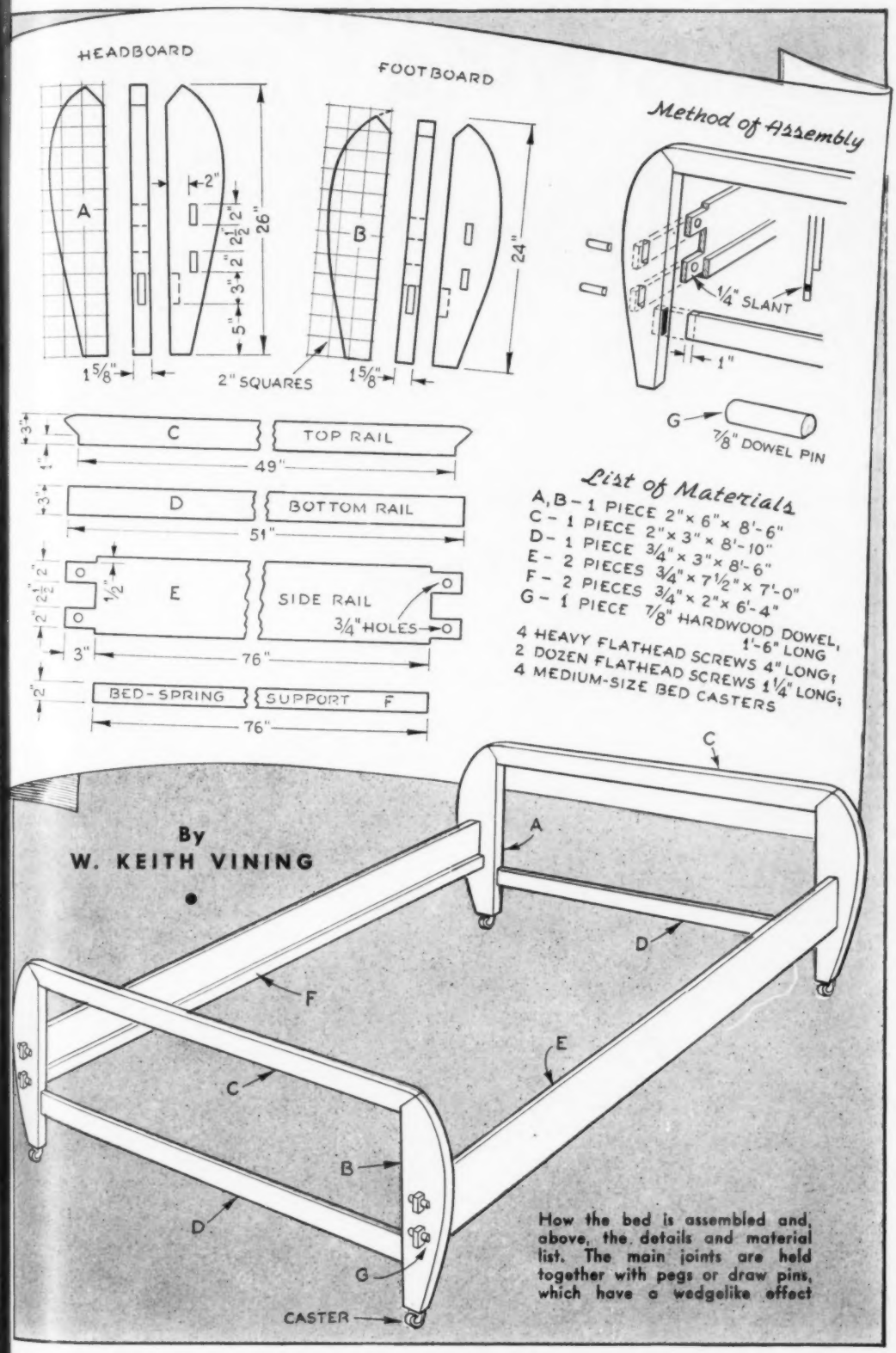
Enlarge the patterns for the posts to full size, lay them out, all four of them, on 2" by 6" stock, and cut them to shape. The mortises for the long rails begin 8" from the bottom of the posts and 2" from the inside edge. The mortises for the front and back bottom rails begin 5" from the bottom of the posts and are 1" deep. The rails themselves are ¾" by 3" by 4' 3" long and fastened with short screws driven into the tenons.

The front and back upper rails, which are of 2" by 3" stock and 4' 5" long, are joined to the posts as shown and fastened with long screws driven diagonally. These screw heads are countersunk and concealed with glued wooden plugs. Don't attempt to round the tops of the upper rails into the curve of the posts until after the parts are assembled.

The side rails, ¾" by 7½" by 6' 10", have double tenons at each end as indicated. The strips of ¾" by 2" stock are fastened along the bottom of each to hold the bed springs. The holes for the pegs or draw pins are ¾" in diameter and taper in from the outside about ¼" so the pins will draw the frame members snugly together. The draw pins are made from a dowel and are 2" long.

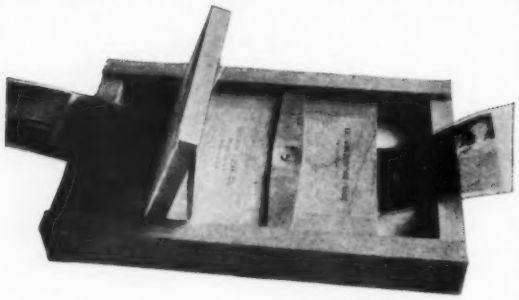
The bed may be finished either with stain or varnish or with enamel, as desired.

The charm of this unusual design lies in its simplicity and excellent proportions



How the bed is assembled and, above, the details and material list. The main joints are held together with pegs or draw pins, which have a wedgelike effect

Timesaving Hints for H

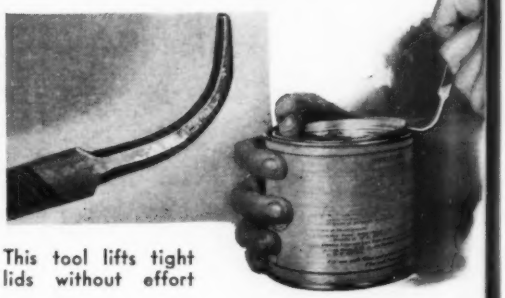


Printing Uncut Roll Film in an Ordinary Frame

AMATEUR photographers at times wish to make prints from roll film without cutting the individual pictures apart. This can be done without a special frame by using an ordinary printing frame at least twice as long as the picture. Pressure is applied with the larger section of the back, as shown, and there is then sufficient room at each end for the film to pass through without danger of becoming creased.—JOHN M. AVERY.

Bent File Tang Pries Up Developer-Can Lids

TO OPEN hermetically sealed cans of photographic developing powders, it is better to make a special lid lifter from an old file than to have to hunt around for something suitable and perhaps end up by ruining the handle of a good teaspoon. Snap off about ½" of the tang, heat the remainder in a gas flame, and hammer it to the required thickness. Then reheat the end and bend it with pliers. Heat it once more, cool it in the air for a few seconds, and plunge it into cold water.—NATHAN SPERBER.



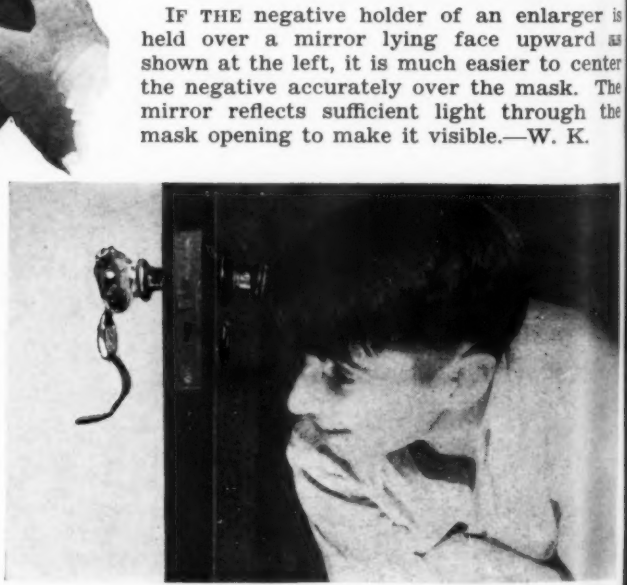
This tool lifts tight lids without effort

Mirror Aids in Centering a Film To Be Enlarged

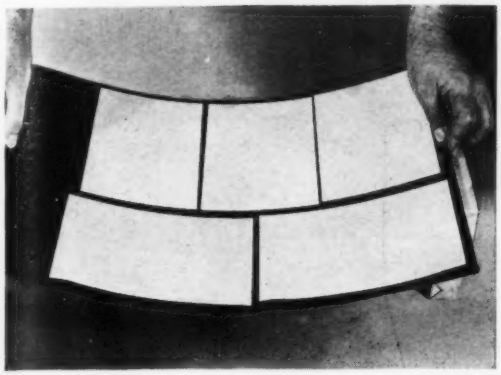
IF THE negative holder of an enlarger is held over a mirror lying face upward as shown at the left, it is much easier to center the negative accurately over the mask. The mirror reflects sufficient light through the mask opening to make it visible.—W. K.

Watch Hung Outside Darkroom Keyhole

IN ORDER to tell the time when developing panchromatic film in total darkness, one photographer fastens his watch outside the keyhole of the darkroom door as shown at the right so he can peer at it through the keyhole. A towel is draped over the inner door knob to keep out all light, but arranged so the folds may be parted.—MORRIS KATZ.



Home Photographers



Curved Ferrotype Plate Gives Flatter Prints

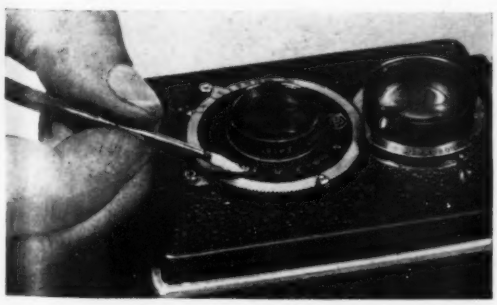
BY BENDING a ferrotype tin to a gentle curve as shown above before placing the wet prints on it, and maintaining the curve by any convenient means until they are thoroughly dry, you can overcome their tendency to curl when taken off the plate.—G. S. G.

Tilt Top Improved with Felt Disk

LOW-PRICED camera tilt tops, which are unpadded, gradually indent the leather near the tripod sockets and cause wear. To prevent this, cut a suitable disk of felt from an old hat or a piece of soft plush and make a hole in the center. Apply cellulose household cement to the disk, let it dry for fifteen minutes, then apply another coat of cement to it and also to the metal, and clamp overnight.

Photo Chemicals Measured with Set of Spoons

WHEN photographic formulas have to be made up frequently, much time can be saved by the use of a ten-cent set of aluminum measuring spoons. Weigh out the required amount of each chemical and see which spoon will hold it. The handle should then be marked with the quantity it will hold, in grains or fractions of an ounce. This can be done by writing with olive oil, after which the aluminum is heated.—C. L.

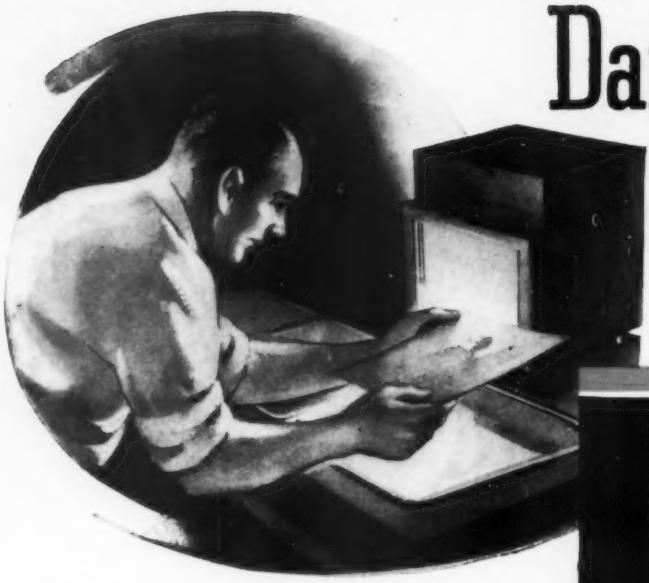


Luminous Shutter Markings Aid in Night Photos

FOR setting his camera shutter at night, a midwestern news photographer made a dot on each pointer and at each figure on the dial of the shutter with luminous paint as at the left. The paint may be purchased in small bottles, or you can grind up the material found in a ten-cent luminous light pendant and mix it with a little varnish.—E. V. B.

Darkroom Safe Light

HAS MANY USES



Unlike many homemade darkroom lamps, this one has the advantage of using standard safe-light glasses

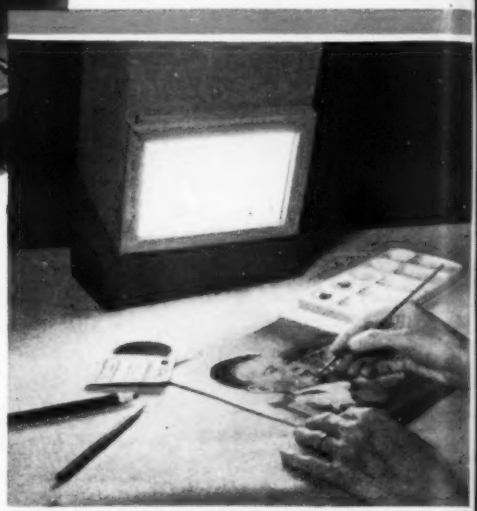
ALTHOUGH it takes up little space in the darkroom, this utility light box, besides acting as a conventional safe light, assists the photographer in tasks for which several separate contrivances ordinarily would be required.

The sketch gives details and sizes for the box, which is constructed from ¼" plywood. Do not fasten the back permanently, but hinge or screw it in place so it may be removed for ventilation when negatives are being retouched. This will prevent them from overheating and curling. Strips nailed to the inside form a light trap.

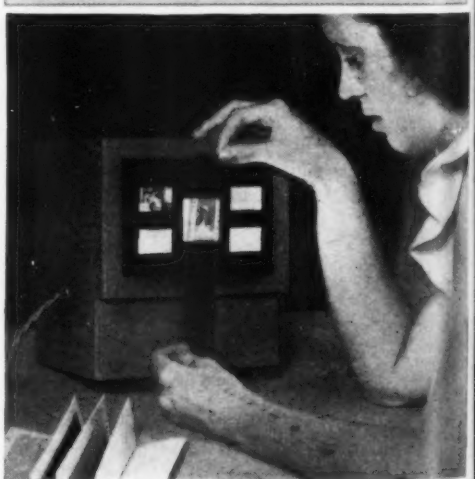
The wider of the two slots in the molding on the front of the box is for the regular 5" by 7" safe lights or a sheet of flashed opal glass, while the narrow slot allows the insertion of cardboard cut-outs for special purposes.

As the box will be used in various positions, a locking arrangement is provided for the movable piece of molding. This is merely a nail that fits in a hole through the top and sidepiece. The lock is positive in action, yet is quickly opened for changing slides. If no dado head is available for slotting the molding, cardboard spacers and thin wood strips nailed together will answer very well.

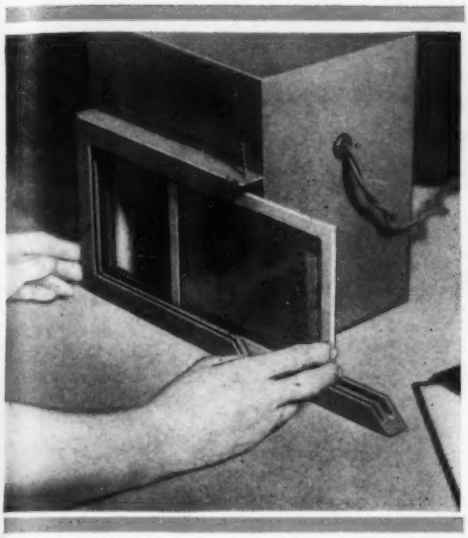
The light socket inside the box is attached by means of a threaded bushing through one end, as indicated, and is held securely by a lock nut on the outside of the box. Wires through this bushing connect the socket with the power supply. A 25-watt lamp is used with the safe lights, but for other purposes the wattage may be varied.—C. ELMER BLACK.

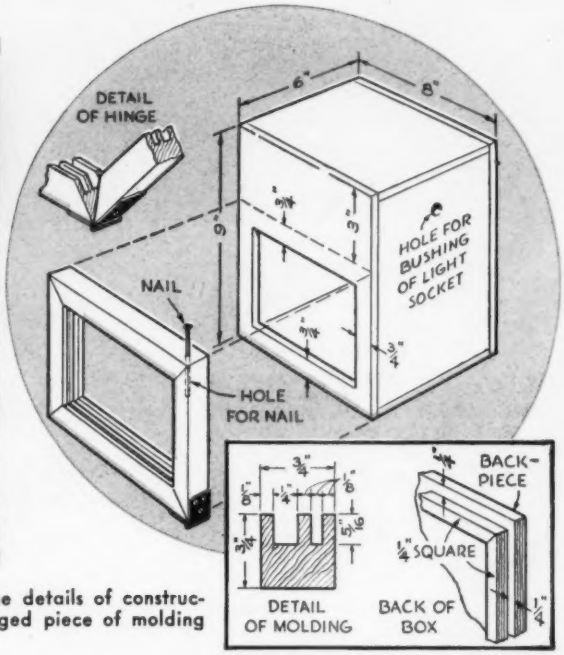


An opal glass gives a soft, white light for spotting prints and for retouching negatives



Sorting negatives according to their contrast by comparison with standard negatives pasted behind cut-outs in a cardboard mask



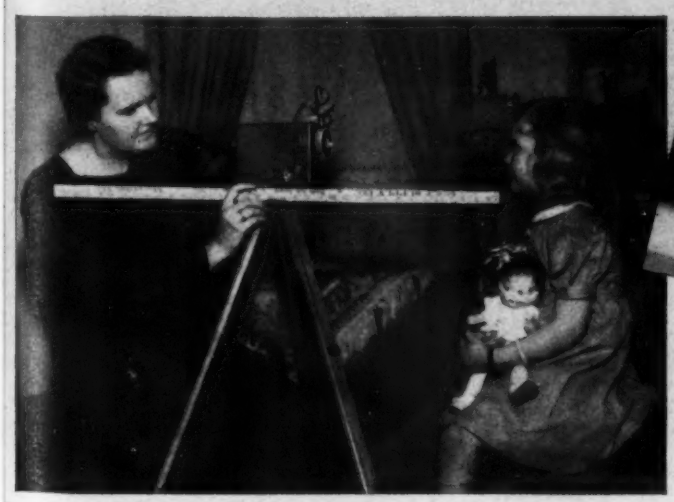


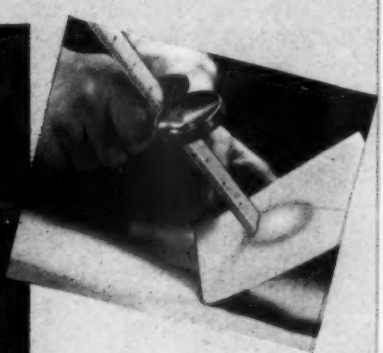
Method of inserting safe lights and the details of construction. Note the nail for locking the hinged piece of molding

Reading Glass Used for Close-ups and Copying

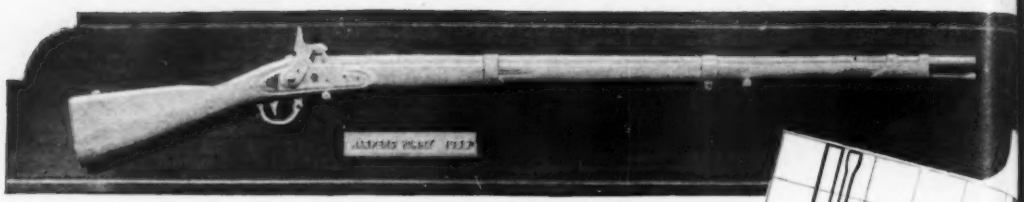
LARGE images of small objects or extreme close-ups may be made with any camera by holding a reading glass in front of the camera lens while making the exposure. A fixed-focus camera will give excellent results. Only two simple rules are necessary to give sharp focus. First, find the focal length of the reading glass and hold it exactly this distance from the object which is to be photographed. Second, if the camera is a focusing model, set it on 100 feet or infinity. Place the camera lens against the center of the reading glass and snap the picture in the usual manner.

To find the focal length of the reading glass, focus the sun to the smallest possible image and measure the distance from the center of the reading glass to the image. If the sun is not shining, focus a distant object such as a tree on a piece of white paper and measure in the same way. The view finder cannot be used so the camera must be aimed by sighting over its top and sides.—CLEMENT W. RICKMAN.





Above, finding focal length of a reading glass. At left, a glass of 20" focal length acts as a portrait attachment



WHITTLED MODEL OF

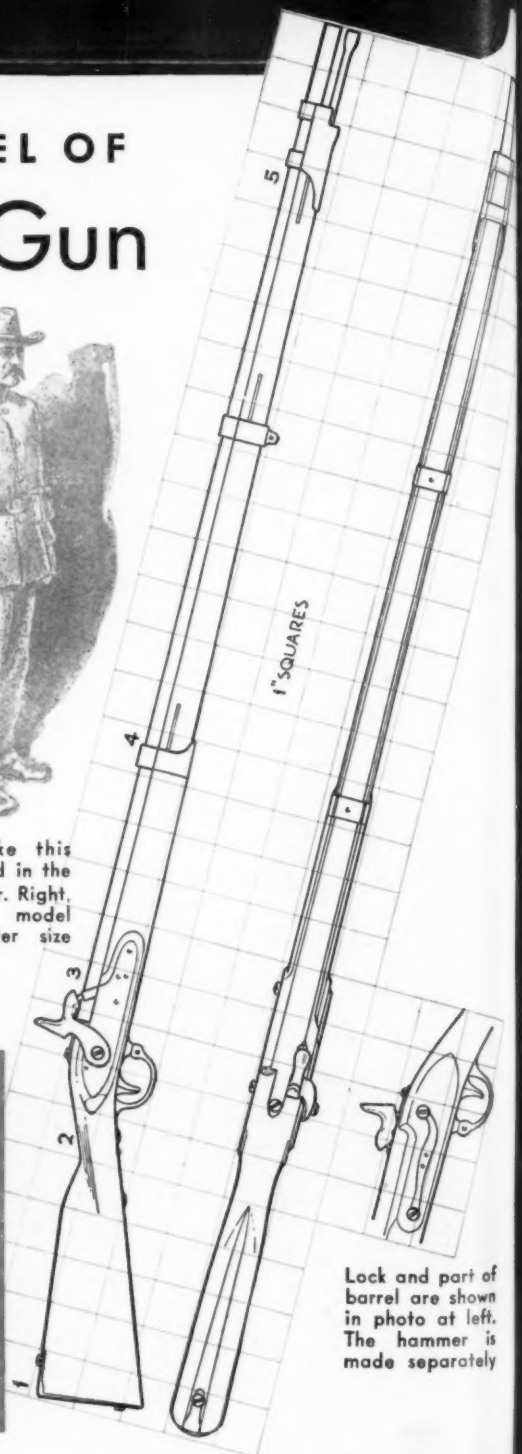
A Famous Gun

CARVED from a white pine board 1⅛" by 4½" by 30", this model is a half-size copy of a picturesque gun made in the government arsenal at Harpers Ferry, W. Va., and dated 1835. The arsenal was destroyed by fire in 1861 to prevent its capture by Confederates.

Enlarge the side-view drawing to four times the size shown, transfer the outline to the wood, and jig-saw it to shape. Draw a pencil center line all around the edge before starting to carve the parts. Keep your knife very sharp so as not to tear the soft wood.

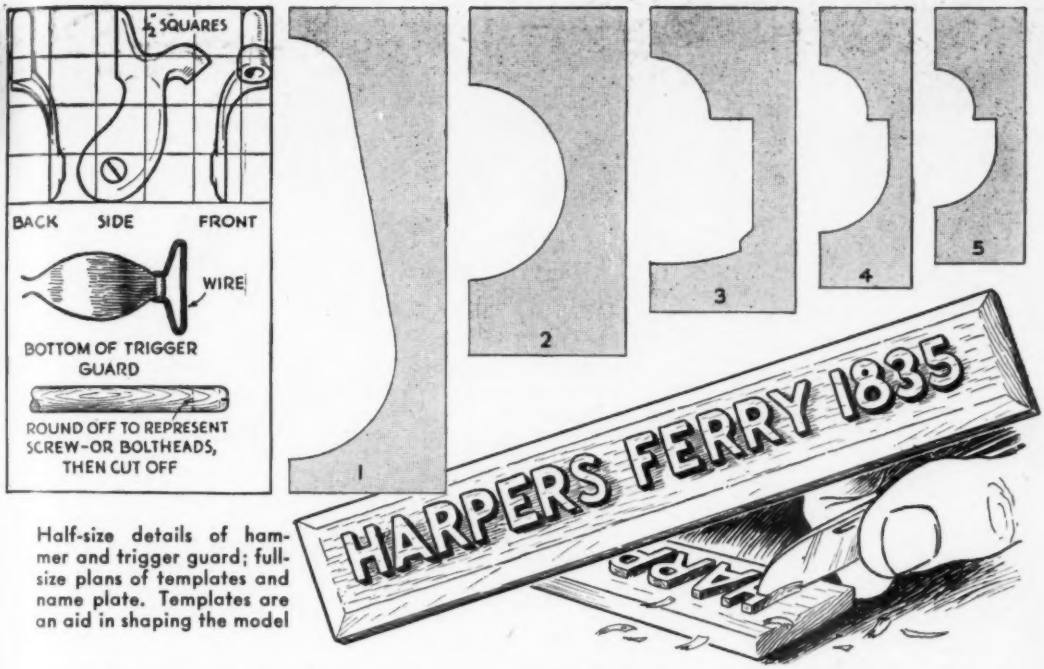
I made the hammer separately, otherwise a thicker board would be required and a great deal more waste stock would have to be whittled away. The ramrod is a particularly thin, difficult part to shape, and it may be added afterward, if preferred, by inserting the end in a hole drilled to receive it. The screw heads are cut from ¼"

Guns like this were used in the Civil War. Right, views of model one-quarter size



Lock and part of barrel are shown in photo at left. The hammer is made separately

By CARL G. ERICH



Half-size details of hammer and trigger guard; full-size plans of templates and name plate. Templates are an aid in shaping the model

dowel sticks, although oval-head wood screws might be substituted. The left side of the gun does not have a carved plate like that on the right side.

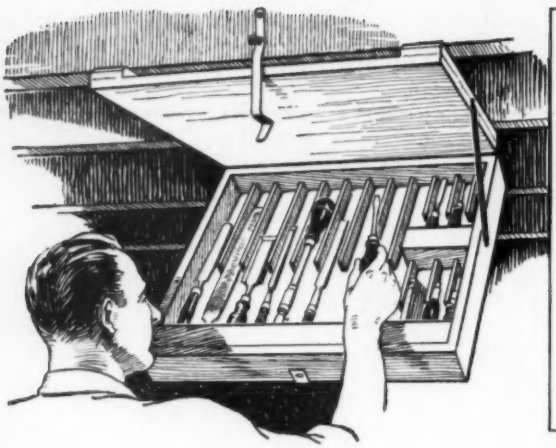
The panel may be any shape desired. To mount the model, insert a ¼" dowel in the panel at the front of the trigger guard, and another about 7" from the muzzle; then drive a small screw from the rear of the panel into the gun.

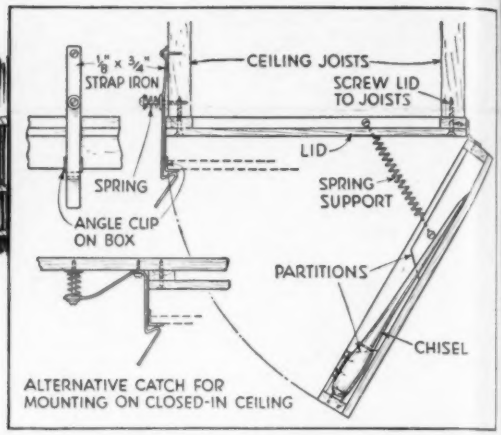
Fastening Cellar Windows

CELLAR windows sometimes become badly warped and let in a lot of cold air because they are improperly fastened. Always use two catches or turn buttons near the bottom, one on each side. Also, in applying the hook and eye that holds the window open, center them, because if the hook is used at one side, the opposite side of the window sags and is likely to take a permanent set.

Food-Grinder Support

TO PROVIDE a place to clamp a food grinder, Leslie R. Wilson, of Anaheim, Calif., uses a board 1¼" thick, 4" wide, and of a length to slide under the working top of the kitchen cabinet. It is slightly tapered so that it wedges solidly into its opening when drawn out.

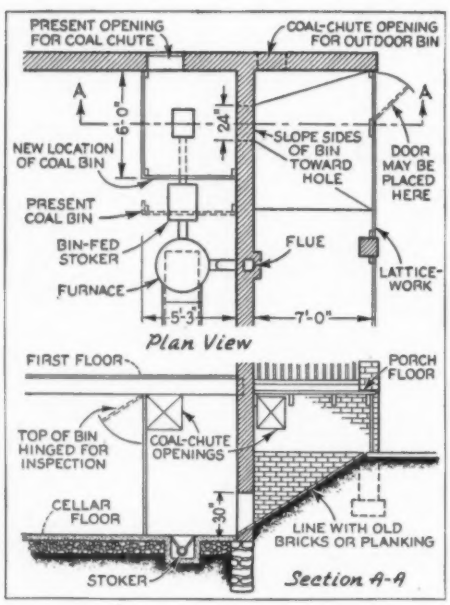




For basement workshops, cabinets of this type keep frequently used hand tools right at your finger tips

Ceiling Cabinets Hold Hand and Lathe Tools

BUILT primarily to protect chisels and gouges from nicks and rust, this ceiling cabinet proved so convenient that a second one was built for various hand tools. The one for the chisels is about 18" by 34"; the second one, 18" by 22" by 2" deep inside. The degree of opening is controlled by a tension spring, adjusted so the case will come to rest at about 30 deg. from the vertical. This makes it unnecessary to clip the tools in place.—J.A.T.



Sloping Coal-Bin Extension Built Beneath a Porch

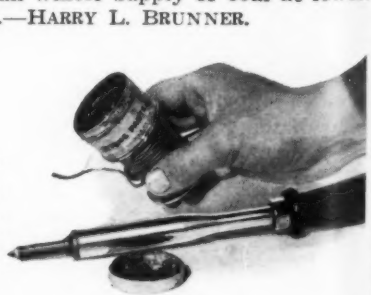
WHEN a mechanical stoker is to be installed in a small basement and extra space is required for coal storage because the present bin must be cut, it is frequently possible to build an extra bin under the porch as shown.

Cut a hole about 24" by 30" through the basement wall, and line the hole with a stiff cement grout to reënforce the ragged edges and make a smooth passage for the coal. Scoop out the fill under the porch so the sides slope toward the hole. Smooth off and tamp solid, then line the slopes with planks or old bricks laid without mortar. Latticework around the porch footing can be replaced with closed panels, if necessary, to keep out the cold or to prevent freezing if the coal is exposed to moisture from a leaky porch floor.

An arrangement of this type enables me to purchase my full winter supply of coal at lowest summer prices.—HARRY L. BRUNNER.

Solder and Paste Kept Together

A CAN of soldering paste and a small spool of wire solder can be kept together for convenient use by fastening them with about three drops of solder as shown at the right. This does not interfere with hanging the spool on a nail or peg, if desired, and both paste and solder can be used while in that position.—RUSS ALEXANDER.



By
PAUL R.
BUSSLER

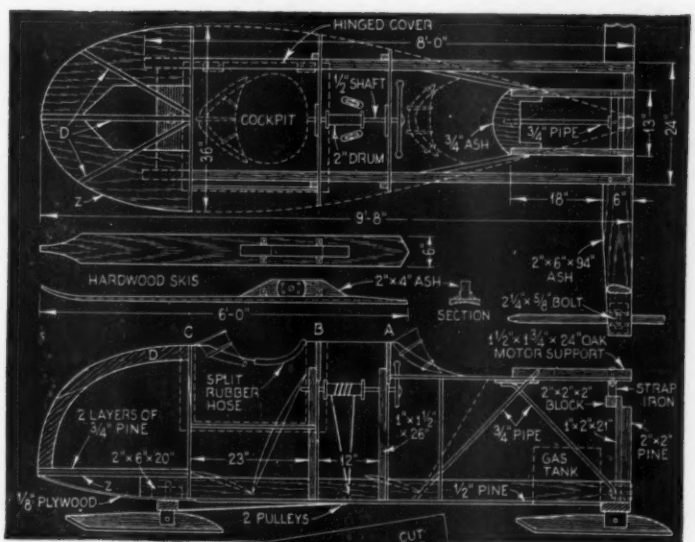
Speedy Ice Sled

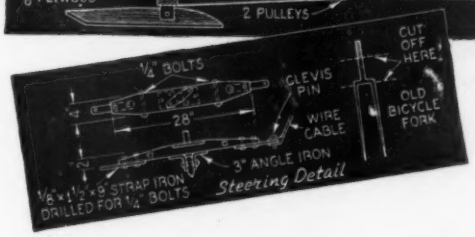
Skis are used on snow, but for ice the sled is fitted with steel runners

DRIVEN BY MOTORCYCLE ENGINE

POWERED by a converted four-cylinder motorcycle engine, this streamline sled will speed across the ice on runners, or it can be equipped with skis to skim over the snow. It is of airplane-type construction and can be built for comparatively little. The overall length is 9′ 8″.

Choose straight-grained 2 by 4's for the chassis. Use ash for the front runner support and drill a hole to take the shank of the bicycle fork, which must be cut as shown. A cotter pin in the top of the shank keeps it from falling out. Draw full-size patterns of *A*, *B*, *C*, *D*, and *Z*. Frames *A* and *B* are the same except for the side fairing, which is made of ⅛″ plywood. Frames *C* and *D* are made in several pieces of ½″ pine spliced together and fastened with thin plywood



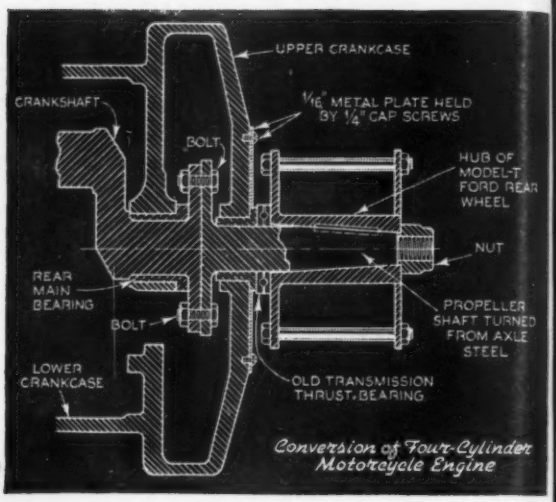


Top and side views showing the general method of assembly. Left, details of the front runner support

cleats. Part *Z* consists of two layers of ¾" pine. Frames *D* are attached to it and to *C* with screws.

Make the support for the two rear runners from ash planed to the shape indicated. The runners themselves are 1" by 4" by 31", sheathed with ⅛" by 1" by 1" angle iron. Sharpen the angle to a knife edge so that it cuts the ice. For use on snow make three skis from hardwood 1" by 6" by 72" and sand the bottom concave as shown. To bend the ski tips, wrap them in burlap and stick in boiling water for thirty minutes; then place under a board nailed to cleats on the floor and bend upward to a 45-degree angle (see "The Expert's Way of Making Skis," P.S.M., Dec. '37, p. 78).

Fasten hardwood blocks ½" thick to frames *A* and *B* after drilling holes large enough to take the ½" steering shaft. Cut off the lower part of an old auto steering wheel and install the steering rod, drum, pulleys, and wire cable.



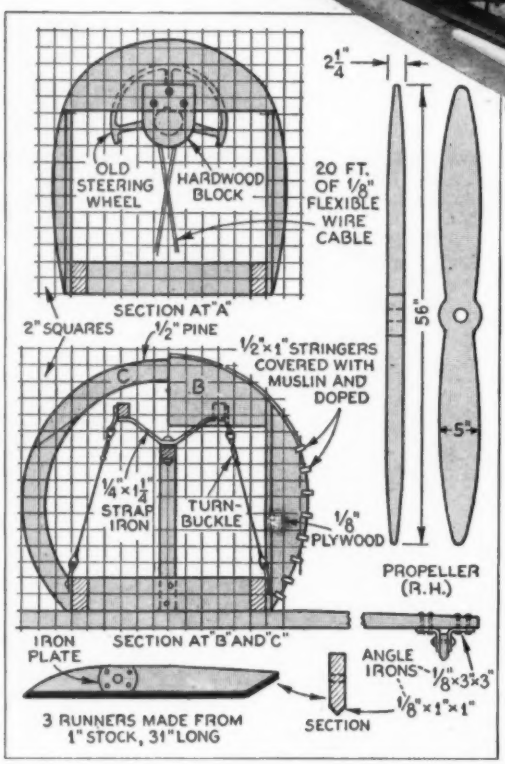
Conversion of Four-Cylinder Motorcycle Engine

The transmission is cut from engine and its thrust bearing used for propeller. Left, sled with runners for ice. Note front cockpit for carrying a passenger

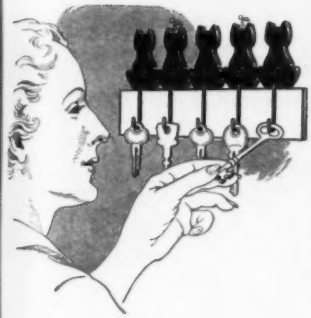
Cover the top of the sled between frames *A* and *B* with ⅛" plywood. Make the framework of the hinged cockpit covering of ½" white pine and cover with plywood also. Cut notches into the fairing for the ½" by 1" stringers along the side and use bamboo stringers around the nose. Cover with muslin and give it three coats of airplane dope. Finish with two coats of paint. The two celluloid windshields are held in place with metal brackets.

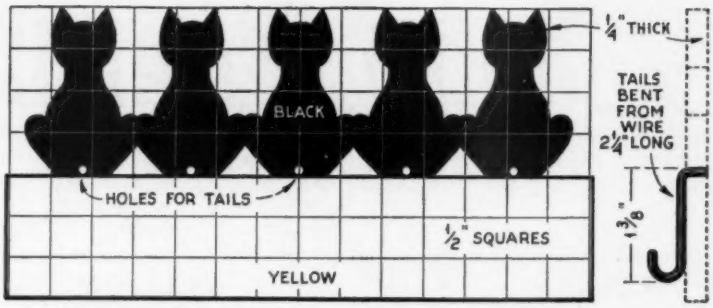
To convert a four-cylinder motorcycle engine into a suitable power plant for the sled may require some ingenuity, but the fundamentals given in the sketches apply to most types. On the original sled, the propeller hub was turned from the hub of a model-T Ford rear wheel, and the propeller shaft from axle steel. The latter has the same taper as a model-T Ford rear axle. The thrust bearing is the same one that was in the transmission. Cut the transmission off the back of the flywheel housing, remove the flywheel, and then bolt the propeller shaft to the crankshaft flange. A pressure system is used to force gasoline up to the engine.

You can purchase a propeller or make one from birch and walnut, or from solid ash. The author's sled does not have a propeller guard, but one should be added if the sled is used where there are many persons around.

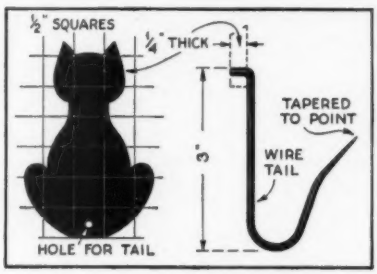


How the three bulkheads are made; side and front views of propeller; method of making the runners





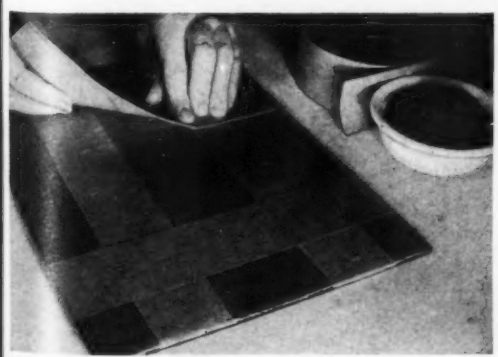
Comical Cat-Tail Novelties Made from Scraps of Wood and Wire

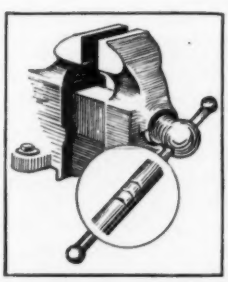


THESE cat-tail novelties—a key rack or hanger for pot holders and a wall spindle—are made from scraps of wood and a discarded wire clothes hanger. The cats are jig-sawed, drilled for the tails, and finished with a coat of flat paint or enamel undercoat followed by two coats of enamel. The tails are bent from pieces of wire, and the one used in the paper spindle is filed to a smooth point. It is advisable to guard this point with a cork. The five short tails are each 2¼" long and the tail for the spindle is a 6" piece of wire. Paint them black before gluing the ends in the holes.—CARL L. SORENSEN.

Reducing Cost of Mailing Photos and Drawings

IN MAILING photographs, drawings, or other flat material, the weight can be reduced and postage saved by using a single piece of corrugated cardboard instead of the customary two pieces. To make one piece serve this purpost, it may be reënforced by sticking on wide strips of gummed paper. If two strips are used in each direction, as shown, the single board will be stiff enough to give ample protection.—JAMES F. SCHINDLER.





How to Free a Sticking Vise Handle

THE handle of a machinist's vise is intended to slide freely through the ball knob on the end of the vise screw, but in time it is likely to stick because of the accumulation of grease and dirt. To remove this, cut two or three notches in the handle with a sharp chisel; these should be no deeper than the teeth of a fine hack-saw blade. A few strokes of the handle through the ball knob will remove all the hard-packed dirt, and the notches may then be filed off.—DAN MARVOSH.

Use for Blackboard Erasers

FOR sanding flat surfaces by hand, an ordinary blackboard eraser forms an excellent sandpaper block. I am able to find plenty of discarded school erasers to use for this purpose, but new ones are still better.—L. C. T.

Cutting Dovetail Joints on

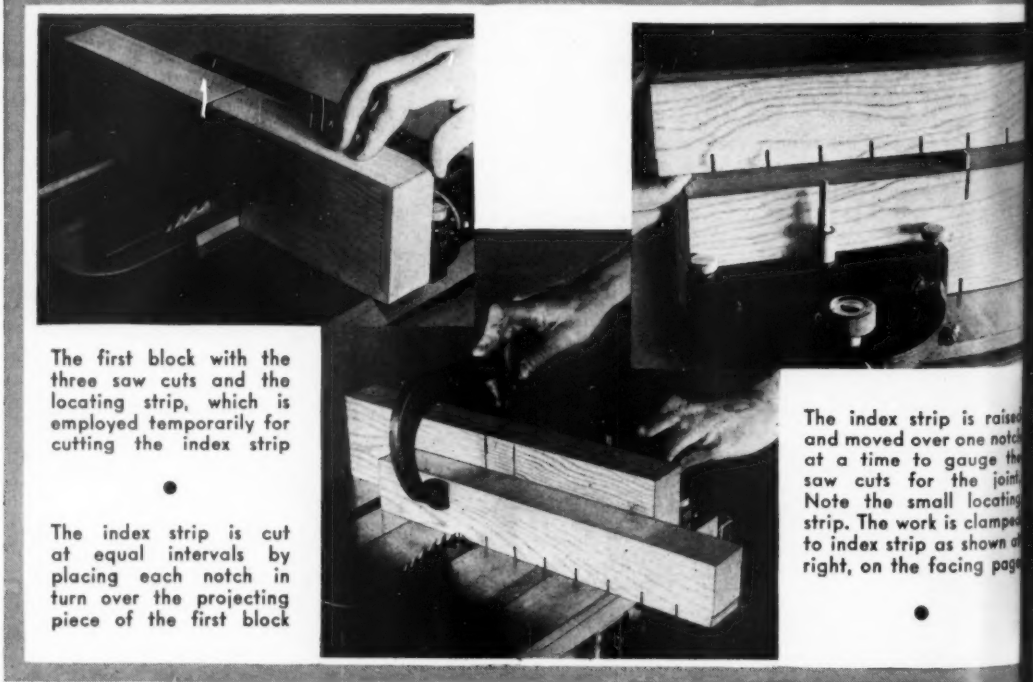
By HOWARD R. HEYDORF

DIFFICULTIES involved in making dovetail joints by hand tend to prevent the average home craftsman from attempting them. This is to be regretted because they are among the best corner joints—attractive in appearance and very strong and rigid. It is possible, however, to make these joints on a circular saw possessing only the regular adjustments.

The wood must be of uniform width and thickness. It is best to rip all the stock at one time to a width slightly greater than necessary. The edges should not be planed till after the joints have been cut. A drawing of the sockets for one joint should be made and transferred to the wood, special care being used to space the sockets equally at the ends.

To insure that all of the saw cuts are the same distance apart, an indexing jig is used on the miter gauge. First, prepare a piece of wood 2″ thick, about 5″ wide, and as long as the saw table is wide. Make a saw cut about ½″ deep in one edge; then move the block over and make a second cut so the distance between the two cuts from center to center is equal to the distance *D*. A third cut is made in the opposite edge directly above the second cut. The block is screwed to the miter gauge in the position in which the second cut was made, and a small strip of wood is fitted into the first cut as shown. The projecting part is sanded slightly thinner.

The index strip is made from a piece of wood of the same length and thickness as the first and about 3″ wide. This is clamped to the front of the first block, and a cut made in its edge near one end. This cut is placed over the projecting strip in the first block, and a second cut is made. The second cut is then slipped over the strip, and the third cut is made. This is repeated until the strip is notched at equal intervals for its entire length. The strip in the front of the first block is now removed. A thin strip of wood with the grain running up and down is glued into the top notch in the first block. It should project about ½″. This projecting end should be sanded slightly thinner. The index strip is placed upon the first block with one of the cuts fitting over the projecting strip. This index strip can then be raised and moved

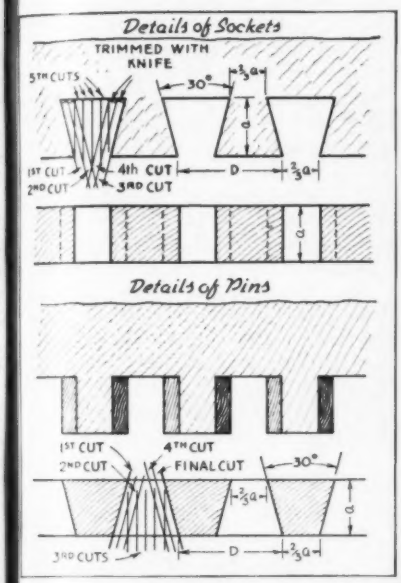


The first block with the three saw cuts and the locating strip, which is employed temporarily for cutting the index strip

The index strip is cut at equal intervals by placing each notch in turn over the projecting piece of the first block

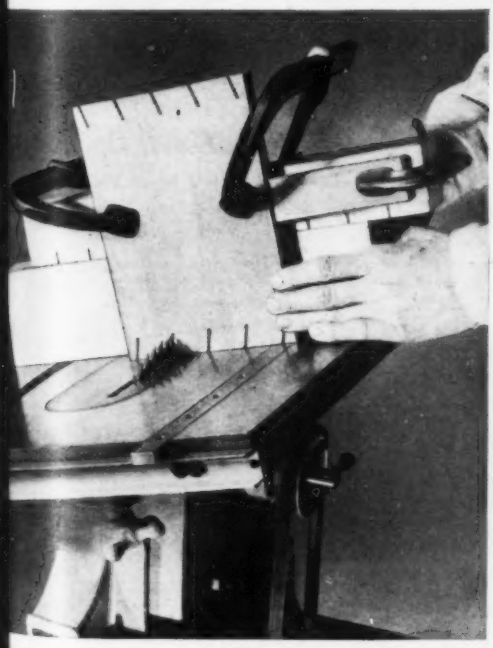
The index strip is raised and moved over one notch at a time to gauge the saw cuts for the joint. Note the small locating strip. The work is clamped to index strip as shown at right, on the facing page

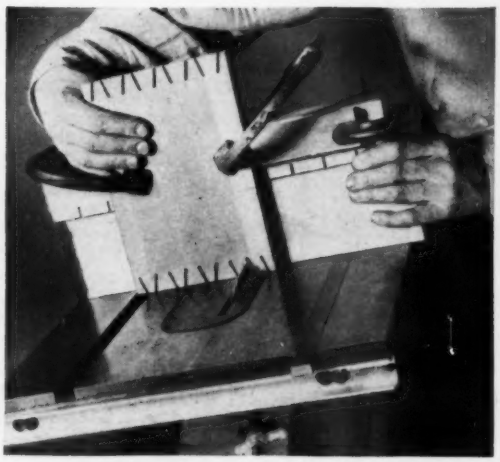
on a Circular Saw



Dimension a is equal to thickness of wood, and D is equal to the distance between any two corresponding parts

To remove the center waste, return the saw table to level and use the saw blade, not a dado head. Finish corners with knife or file



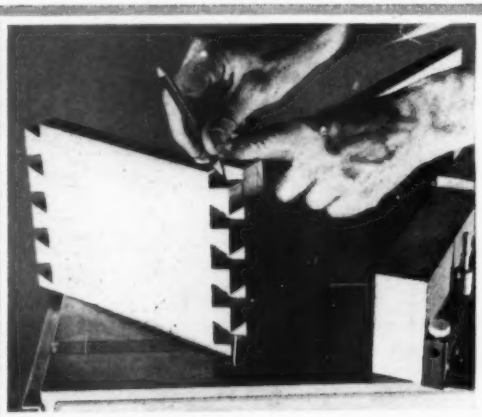


Left, cutting the first side of the sockets. The bed of the saw is tilted at a 15-deg. angle. A small stop strip is clamped to the index strip to locate the position of the first cut. Below, the wood is reversed to cut other side of sockets

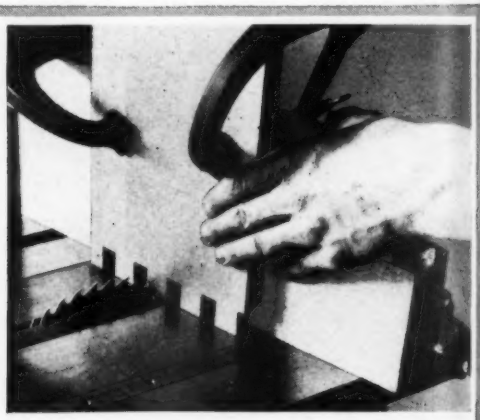
over one notch at a time to gauge the saw cuts for the joint.

The bed of the saw is tilted at a 15-deg. angle. The material is clamped to the index strip as shown and the sockets are cut first. This should be done in such a position that the saw blade just shaves the line in the inside of the first socket. The cuts for the other sockets are made by moving the material and the index strip over one notch at a time. The other end of the material is then cut. A small stop strip clamped to the index strip will quickly locate the position of the first cut. The stop strip is next moved over the thickness of the saw blade and another cut is made on the inside of the sockets, as shown in the drawings. The material is reversed and the other side of the socket cut in a like manner. Next the material is removed from the center of the socket as shown. It is not advisable to use a dado head because of the tendency to chip the edges. The corners of the sockets should be finished with a sharp knife or a file.

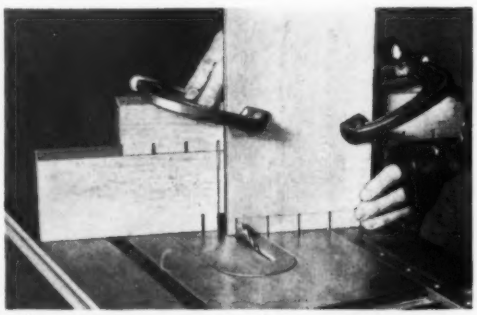
After the sockets are cut, the position of the pins should be marked from the sockets. The sections that are to be removed should be blackened to prevent any mistake. When more than one joint is to be made, it is best to cut them and finish them one at a time, although this applies only to the pins. The miter gauge is turned to a 15-deg. angle and the material clamped to the index strip. The first sides of the pins are cut and another cut made on the inside of this. This is similar to the sockets and is shown in the drawings. The miter gauge is returned to the square position, and the center material is removed in the same manner as the sockets. Next, the miter gauge is turned to a 15-deg. angle in the opposite direction, and the other side of the pins are cut. It is best to make the inside cut first, gradually working towards the pin. The material is shifted slightly after each cut. These slight cuts are made on all of the pins by using the index strip. When the pins will slip into the sockets with a snug fit, the joint is completed.



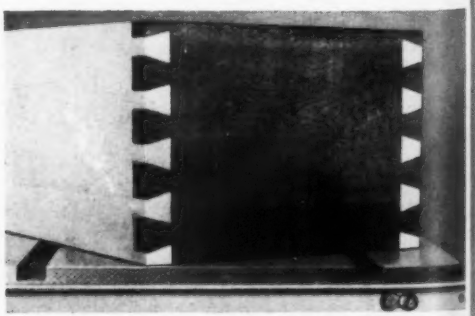
The location of the pins is marked from the sockets. To avoid mistake, blacken with a pencil the waste parts of wood to be removed



Cutting the other side of the pins. The material is removed gradually from this side until the pins slip into the sockets with a snug fit



The miter gauge is turned to a 15-deg. angle and the stock clamped to the index strip so that the first side of the pins may be sawed

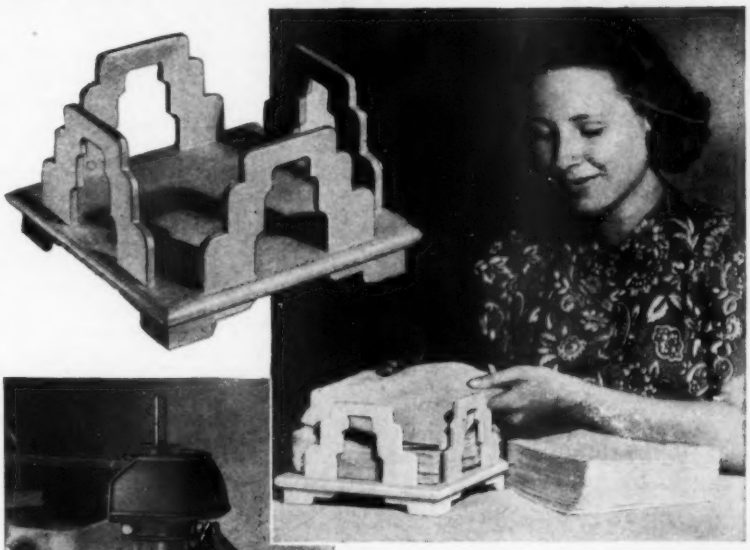


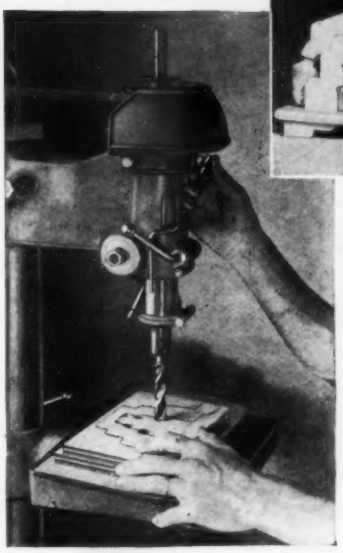
Completed dovetail joint. All pieces are the same thicknesses, but by making a suitable layout it is possible to use different thicknesses

Handy Table Holder for Paper Napkins

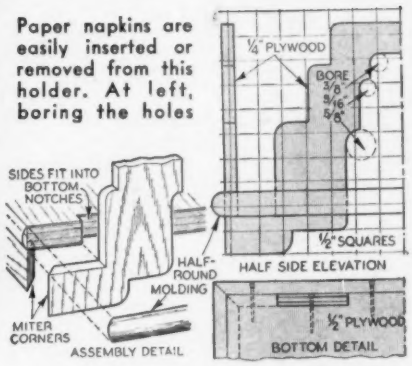
THERE'S no denying that paper napkins are growing in popularity, and a handy, neat-looking dispenser for table use is something that any housewife will appreciate. To make a container like the one illustrated, four plywood blanks for the sides are nailed together, bored for the inside curves, cut out on jig or band saw, and smoothed by using a file in the jig saw before the stack is taken apart. Sand the sides, miter the lower corners, and make a bottom notched to receive the sides. Nail the parts together. A piece of half-round molding, ripped from a hardwood dowel stick, is mitered around the assembly.

Either one- or two-color effects are suitable for this piece Ivory, with blue tones brushed into the tops of the edge steps and the molding while the body color is still wet, is an attractive finish.





Paper napkins are easily inserted or removed from this holder. At left, boring the holes



Nonslip Dressing for Belts

WHEN small round leather belts on power tools have a tendency to slip under load, the following belt dressing will remedy the condition: In a discarded shoe-blacking tin, melt approximately three parts by volume of ordinary rosin, two parts of mutton tallow, and one of castor oil. Stir with a stick until a complete admixture is obtained. The compound, when cool, is smeared on the belt. If the mixture is too stiff, due to too much rosin, increase the amounts of tallow or castor oil until the desired consistency is obtained.

Sealing Bicycle-Tire Leaks

VERY small leaks in ordinary bicycle tires may be sealed, in the absence of a commercial nonleak mixture, by making a thin paste of oatmeal, flaxseed meal, or bran with half water and half denatured alcohol. Insert this as shown above after removing the valve core.

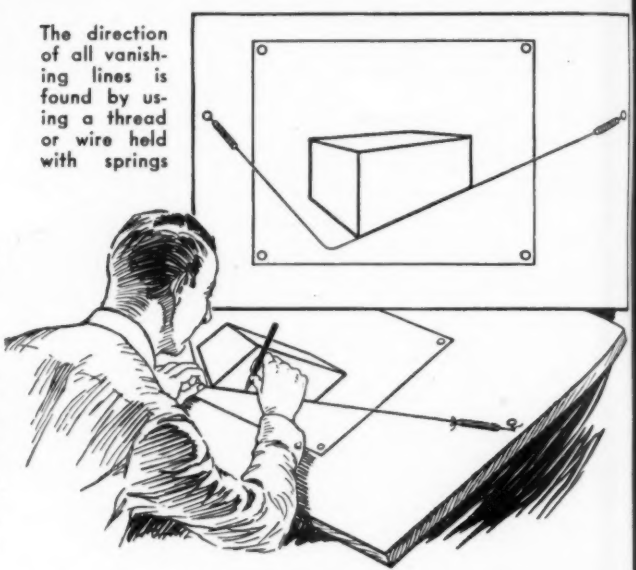
Pump Spout Grooved to Hold a Pail

WATER pails can be more conveniently filled at a common hand pump of the type illustrated if two grooves are filed in the spout or trough in which to place the wire bail. No space is then needed for setting up a stand on which to rest the pail. File the grooves near the open end.—G. W. BATTEN.

Spring-Operated Vanishing Line for Perspective Drawings

SIMPLE perspective drawings may be laid out quickly on either drawing board or blackboard by attaching a thin string or wire to the two vanishing points on the so-called "horizon line" by means of two small coil springs as shown below. This "vanishing line" may then be drawn up or down. Strong linen thread or a steel violin E-string may be used for the line, and two coil springs of good quality ⅛" or 3/16" in diameter and from 1" to 2" long will provide the necessary tension. For blackboard use, larger springs and stronger cord or wire are required.—FRANKLIN H. THOMPSON.

The direction of all vanishing lines is found by using a thread or wire held with springs



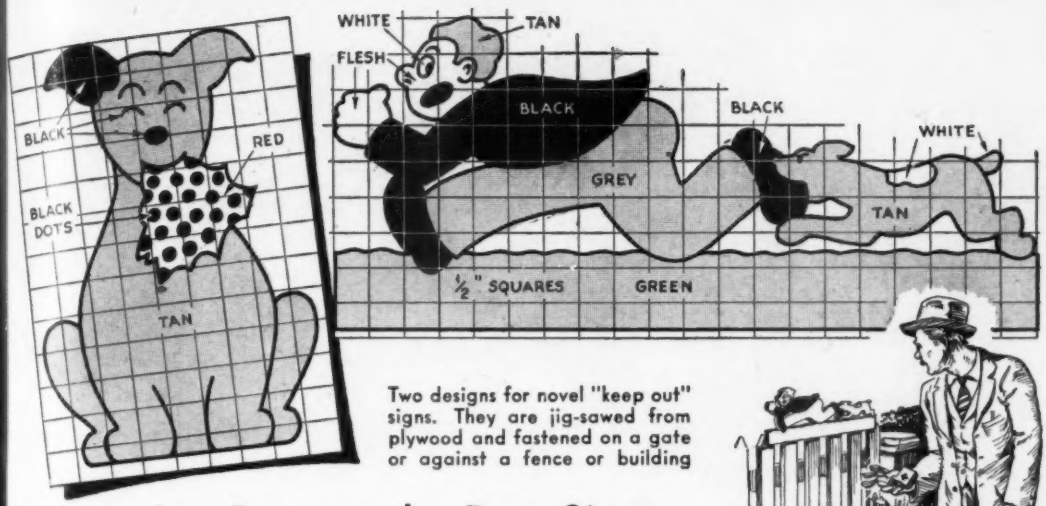
NAIL SIZES [HARDWARE]

Size 2d	3d	4d	5d	6d	7d	8d	9d	10d	12d	16d	20d	30d
Length (in.) 1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	4	4½
Diameter common nail ●	●	●	●	●	●	●	●	●	●	●	●	●

Approximate Number of Nails to a Pound

Common nails and brads.. 876	568	316	271	181	161	106	96	69	63	49	31	24
Casing and box nails ..1010	635	473	406	236	210	145	132	94	88	71	52	46
Finishing nails 1351	807	584	500	309	238	189	172	121	113	90	62	..
Flooring brads.....	...	...	...	157	139	99	90	69	54	43	31	..

POPULAR SCIENCE MONTHLY SHOP DATA FILE



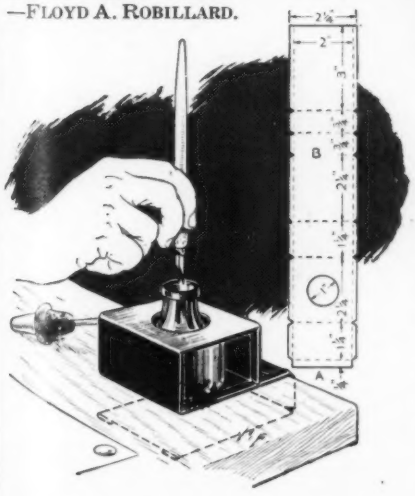
Two designs for novel "keep out" signs. They are jig-sawed from plywood and fastened on a gate or against a fence or building

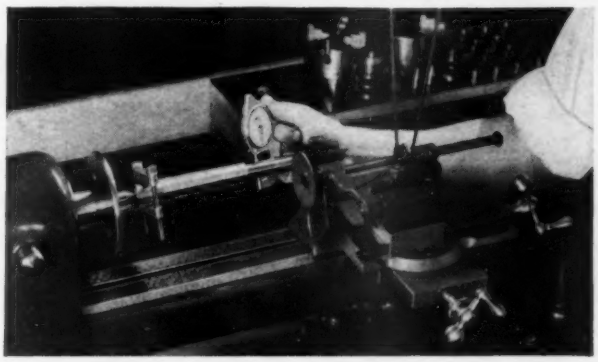
Amusing Beware-the-Dog Signs

INSTEAD of a plain keep-out sign, a piece of scrap wood or plywood jig-sawed in one of the designs illustrated will serve as a warning that a dog is guarding the premises. Such signs will find a ready market among your dog-owning neighbors. The originals were made of ⅜" plywood. The backs and edges were stained, and the fronts enameled in the colors noted. Two coats of clear spar varnish were then applied over all to protect the wood from the elements.—CARL L. SORENSEN.

Ink Holder Clamps on Drawing Board

A SAFE, clamp-on type of ink-bottle holder for the drawing board or drafting table can be made from one piece of thin metal as shown. The lip marked *A* slides under the hem at *B* but is not otherwise fastened, so it is easy to change bottles. The original was cut from thin galvanized iron, then enameled black.
—FLOYD A. ROBILLARD.





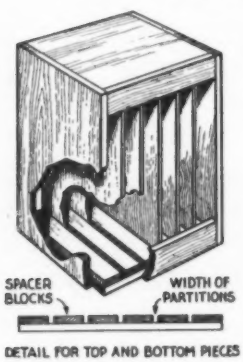
Tool-Post Grinding Attachment

PRECISION in tool-post grinding is assured by the economical and somewhat unconventional set-up shown above. The spindle could be made from a discarded machine part, and the housing fitted to a base dovetailed for the swivel member of the cross-feed slide. In this case the spindle is operated at 5,000 r.p.m. by a steel drum driven from the line shaft. This speed is satisfactory for a 5" by ⅛" rubber-bond grinding wheel.

To work out a similar set-up for the home workshop, a 1,725-r.p.m. motor and a wooden drum may be used. The drum should be 6" in diameter and long enough to permit at least a 6" traverse. If the drum operates at the motor speed and a 2½" pulley is used on the spindle, the surface speed will be satisfactory.

Trays for every purpose are kept handy on top of the refrigerator

Cabinet Provides Place for Serving Trays



The cabinet is merely a box divided by thin partitions to suit the trays

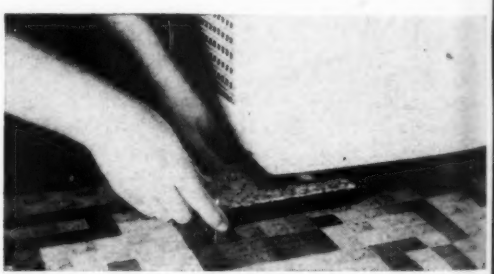
SERVING trays may be kept out of the way yet quickly available in a cabinet of the type illustrated. The bottom and sides are ¾" lumber, the partitions either plywood, hard-pressed composition board, or even fiber wall board. The size and spacing should be designed to fit the trays in actual use, and a door may be added if desired. I put strips of wood, as shown, along the top and bottom to improve the appearance as the cabinet is kept on top of the refrigerator. It is fastened to the wall with angle irons.—WILLIAM J. FRITZ, JR.

Pipe Cleaner Used as Wick for Cigarette Lighter

IF YOUR cigarette lighter requires a new wick, you can save time by using an ordinary thin pipe cleaner. Because of its wire core, the cleaner can be pushed into place in a moment, whereas a wick of the usual type must be coaxed into the hole.—W.C.W.

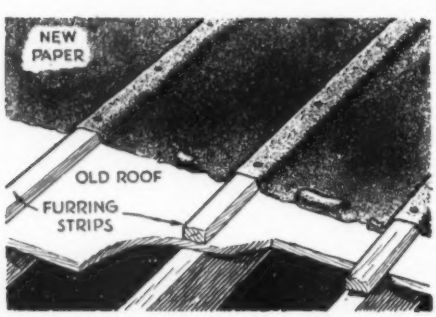
Silencing the Vibration of an Old Refrigerator

ELECTRICAL refrigerators, especially those of the old types, sometimes get noisy, and if they are placed where the floor joists are weak or the span of the joists is unusually long, they may set up an annoying vibration. In bad cases the vibration can even be felt in the window sash of the second floor. This condition can be overcome or relieved by setting cross pieces of soft pine or 4" squares of ½" thick insulating board under the corners. These are inconspicuous and will absorb the vibration.—JAMES F. SCHINDLER.

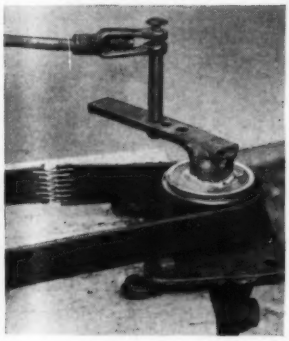


Crosspieces of soft pine or squares of insulating board absorb the vibration of a noisy refrigerator

Leaky Shed and Barn Roofs Repaired at Low Cost



SHEDS, farm shops, and old barns often have badly leaking roofs, yet are not worth the cost of a first-class new roof. In one such case a temporary repair was made about nine years ago, and the roof is still shedding water. All that was done was to nail 1¼" by 2" furring strips over each rafter from ridge to eaves and apply tar-paper roofing over them, running similarly from ridge to eaves. All the nailing was done on the furring strips, and the paper was pressed down between the strips. The joints and nailheads were tarred, and the ends of the paper well lapped over the ridge.—W. F. MESSENGER.



The large photo shows the complete machine with the grinding tool in place, but without the mirror

MACHINE GRINDS AND POLISHES

Telescope Mirrors

PROSPECTIVE telescope builders may save themselves hours of tedious hand labor by constructing a grinding and polishing device of the type illustrated. It is designed for 8″ or smaller mirrors.

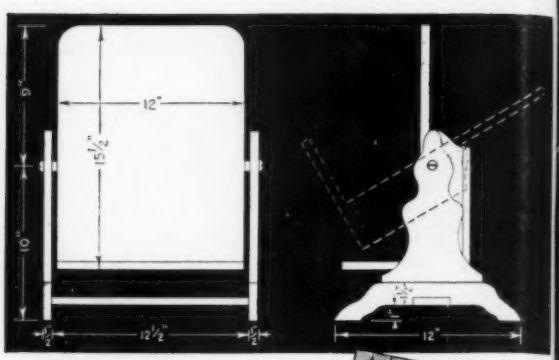
A 1923 Chevrolet steering column of worm-gear type provides a continuous turning movement of the turntable at the rate of seven revolutions a minute, and the grinding tool is moved across its diameter at forty strokes a minute. The spool on the steering arm serves as a pulley, and a 6″ arm is welded to a nut that screws on the end of the arm above the pulley.

A belt runs from the pulley to the rubber-covered turntable. This is 16″ in diameter and composed of two 2″ by 8″ planks crossed by two others of similar size. A ¾″ floor flange is attached in the center of the underside, and a ¾″ by 10″ nipple is screwed into the flange. The nipple passes through the bench and turns in a ball-bearing race.

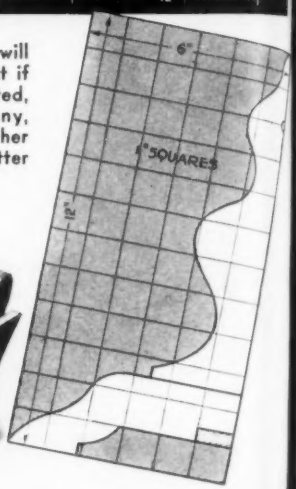
To move the grinding tool, a 1″ by 2″ wooden crossbar is bolted to the 6″ arm above the pulley by means of a piece of brake rod and a nipple. The ¼″ bolt is fastened to the arm in a position to give a 3″ offset and provide a 6″ stroke. The machine is driven by a ¼-h.p. motor through a countershaft made from an old polishing mandrel.

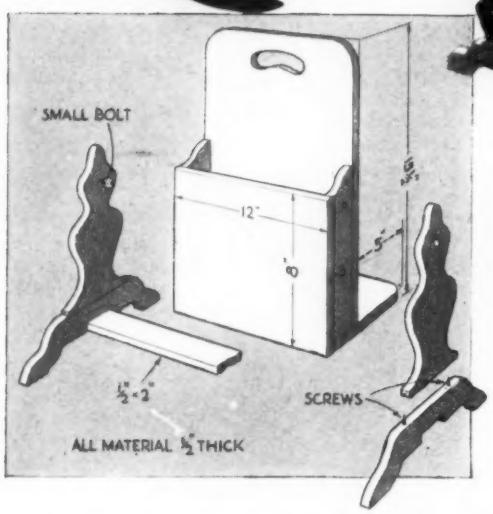
After the mirror blank has been ground, the whole surface is carefully cleaned, and the grinding tool is replaced by the pitch lap for polishing.—PAUL M. BALDWIN.

"Lazy Leg"
FOOT REST AND MAGAZINE RACK



Almost any wood will do for the foot rest if it is to be painted, otherwise mahogany, maple, gum, or other cabinet wood is better



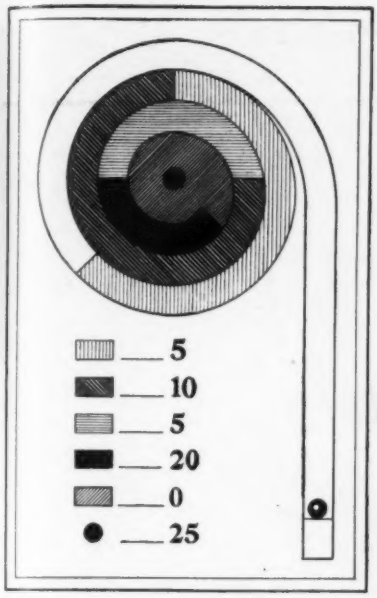


FOOT rests of the so-called "lazy leg" type are made in many styles, both with and without magazine holders, but here is a new and unusually attractive design. Unpainted gumwood ½" thick was used for the one illustrated, but a similar foot rest constructed of knotty pine has proved just as popular. The parts are assembled with finishing nails and glue, and the rack is pivoted on either a small bolt with a countersunk nut or on a No. 7 oval-head wood screw.—L. R. BROWNE.

The earth for the plants is held in compartments made of furnace clinkers

Dish Garden Built with Clinkers

NOVEL miniature gardens may be made with a few hard clinkers from the furnace, some Portland cement, and various small ornamental buildings, bridges, birds, and animals obtained at a ten-cent store. The clinkers are cemented in a platter, tray, or bowl so as to form small partitions. Then the ornaments are cemented in place, the whole painted, and plants set in.—W. J. FRITZ, JR.

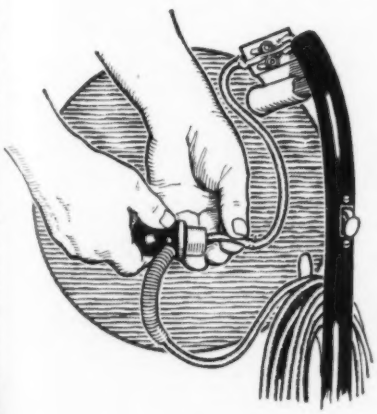


Twirl . . . A MINIATURE MARBLE GAME WITH SPIRAL TRACK

AN AMUSING little one-finger game may be made as shown from a 5″ by 8″ soft pine baseboard and some strips of thin cardboard fastened on with quick-setting model-airplane cement or household cellulose cement. The spiral track is marked into sections, and each is given a distinctive color. These are indicated in the drawing by shading of various tones. In the center a slight depression ¼″ in diameter is made, and this is painted red.

Each player is allowed one twirl at a time. He places his index finger against a small ball, such as one from a ball bearing, and gives it a quick push. If it stops before reaching the first dividing mark, he is allowed an extra turn. It it stops in the first division, the score is five; in the second division, ten; in the third, five, in the fourth, twenty, and in the central space, nothing, unless it comes to rest in the red dot, when twenty-five is scored. If the ball stops on a color dividing line, it counts nothing. Be sure the board is absolutely level.—DONALD W. CLARK.

TESTING A VACUUM CLEANER [*ELECTRICAL*]



When a vacuum cleaner will not run yet the motor armature turns freely and the brushes are in good condition, the trouble is usually due to a broken cord or a defective switch. Remove the necessary parts of the handle and feel the cord for a "soft" spot, which indicates a break in the wire. Test the cord, if necessary, by plugging it in and using a test lamp (see "Testing a Flat Iron," P.S.M., Dec. '38, p. 176). Cut the cord off at the break, if any, and make up connections as before. The switch may be removed for examination by disconnecting the wires and pulling it through the handle after loosening the retaining screws.

POPULAR SCIENCE MONTHLY DATA FILE

Hobbyists, Attention

POPULAR SCIENCE MONTHLY — OFFICIAL GUILD MAGAZINE

NATIONAL HOMEWORKSHOP GUILD

347 FOURTH AVENUE, NEW YORK

Dear Fellow Craftsmen:

Do you want to get more pleasure and profit out of your workshop? If so, you'll find that membership in a home workshop club offers one of the best ways to do it. You can hardly realize the many advantages until you actually meet regularly with friends and neighbors who enjoy the same hobby. Talks and demonstrations by experts, moving pictures, and other program material are available free to clubs — benefits that an individual cannot obtain, even if he is willing to pay for them.

More than five years ago the National Homeworkshop Guild was organized just to help men like you. Full information on how you can start a club in your neighborhood will be sent free upon receipt of a stamped, self-addressed envelope. As soon as your club gets under way, you can participate in the Guild's many free services.

Here is what the Guild does for each club: issues a charter, supplies annual membership cards, provides national publicity, conducts a program service bureau, issues a monthly bulletin full of new ideas, distributes job sheets and other information, gives "A Manual for Home Workshop Clubs" to every new club, and publishes special bulletins on subjects of vital interest to members. All this is possible because of the tremendous growth of the Guild and the support it receives from its official magazine, Popular Science Monthly.

Now is the time to start a club, so use the accompanying coupon. We will be waiting to hear from you.

Sincerely yours,

C. A. Korch

C. A. Korch, Secretary

National Homeworkshop Guild
347 Fourth Avenue, New York

Please send me complete information about your free membership plan. I am anxious to belong to the National Homeworkshop Guild and believe that a club can be started in my neighborhood.

For your use in sending me this material, I am inclosing a large (legal size), self-addressed, stamped envelope. I understand that this will not obligate me in any way.

NAME.....

ADDRESS.....

CITY.....STATE.....

(Please print very clearly)

Annual exhibition in a store window of craftwork made by the Edison Homeworkshop Club of Chicago, Ill.

Guild Starts Sixth Year

WITH RUSH OF ACTIVITY

A SHORT distance outside Buffalo, N.Y., the Bison Builders Guild of that city, a club affiliated with the National Homeworkshop Guild, has just completed a small building to serve as its clubhouse. Bud Haberl donated the property, and the members chipped in to pay for the lumber.

There are two rooms—a shop 30′ by 45′ and a small library. Two long workbenches line the sides of the shop. Equipment includes a circular saw, jig saw, lathe, shaper, and hand tools, all purchased by the members. Thirty men belong to this active club, which was organized less than a year ago.

Members of the Rockford Homecraft Club, which holds Charter No. 1 in the Homeworkshop Guild, watch a lathe demonstration

Throughout the United States and Canada other clubs are enthusiastically forging ahead as the Guild begins its sixth year of existence. Reports at headquarters in New York indicate that club activities will be more varied and intensified than ever before in its history.

The Mark Twain Homecrafters of ***Hannibal, Mo.***, have secured the coöperation of the local public library, and many home workshop books have been purchased for the use of members. Secretary A. O. Riley reports: "We have had a very good year. Organized

A. O. Stenwick, of Red Wing, Minn., puts a few finishing touches to a bowl he has carved. Above, two other projects

with thirteen members, we now have over forty. We receive hearty coöperation from the press, the library, and everyone else. Thirty toys were made and given to the Orphans Home for Christmas. We have had one picnic, a guest night, six demonstrations, and several good talks, and hope to do better this coming year."

The Mazda Homeworkshop Club of ***Euclid, Ohio,*** finds that the most satisfactory method of arranging programs is to assign each meeting to two members. Subjects covered include boat launching, pottery making, pinhole cameras, bird houses, and jig saws.

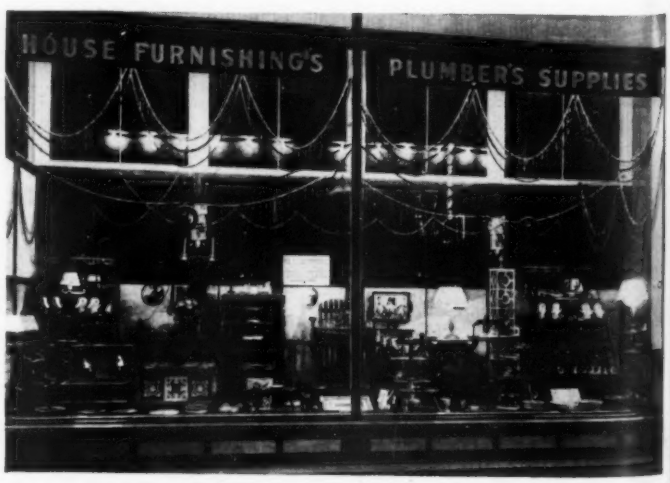
More than 15,000 persons attended the Wright Hobby Show in which the Passaic County Homeworkshop Club, ***Hawthorne, N.J.,*** participated. The club won a silver cup for the best group exhibit, and many individual prizes were captured by the members. Plans are already under way for next year's show. Hobby horses, small wagons, wheelbarrows, cabinets, ring-toss games, doll chairs, and mechanical toys were made for distribution to poor children at Christmas.

George H. Wilson was guest speaker at a recent meeting of the ***Denver (Colo.)*** Homeworkshop Club . . . Plans for the new year were discussed by the ***Nutley (N.J.)*** Homeworkshop Guild at the home of the president, Edward J. Littig . . . New officers of the South Shore Homeworkshop Club, ***Quincy, Mass.,*** are Parker Davis, president; Louis Sanders, vice president; Stephen H. Page, secretary; Alfred Moore, treasurer . . . A large number of Christmas toys were made by the ***Louisville (Ky.)*** Homeworkshop Club, which has been active in this work for several years . . . The Ohio Valley Homecraft Club of ***Wheeling, W.Va.,*** has been enjoying a series of demonstrations on home workshop machinery, including the jig saw, circular saw, woodworking lathe, and metal lathe . . . At the annual social of the Tri-City Homeworkshop Club, ***LaSalle, Peru,*** and ***Oglesby, Ill.,*** R. J. Charles was named president, Earl Gealow, vice president, and A. Hammerich, secretary-treasurer.

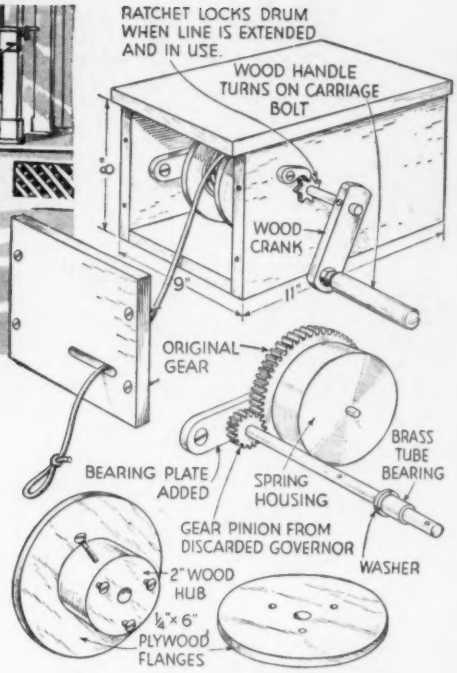
"Safety Glass," a moving picture, was shown to the Town Hall Homeworkshop Club of ***Ottawa, Ill.*** Toys were repaired for the Red Stocking Club.

A professional wood carver and a man skilled in furniture turning demonstrated their crafts before the ***Walla Walla (Wash.)*** Homeworkshop Club. Each member attending a recent meeting had to make a gavel for some civic organization in the city.

Stephen J. Milos was named chairman of the committee to plan a celebration of the National Homeworkshop Guild's fifth birthday sponsored by the ***Ware (Mass.)*** Craftsman Guild. He is assisted by Victor J. Charland and J. Henry McCarthy.



Each year the club in Jacksonville, Fla., exhibits articles made by members and then sells them for the benefit of local needy children



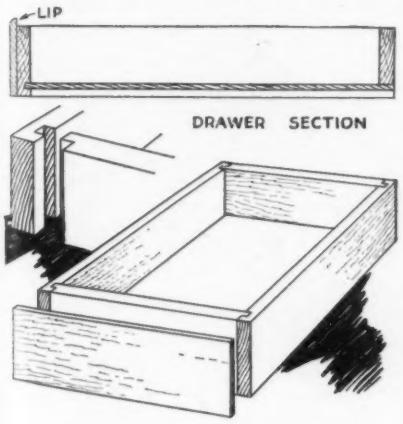
How the spring-winding device is installed. The crank is merely for pulling the line taut

Old Phonograph Motor Winds Clothesline on a Reel

DRIVEN by an old phonograph motor, this automatic clothesline winder literally swallows the line as the housewife walks toward it and thus prevents it from dragging on the ground. The wooden housing protects the line from the weather, soot, and dust when not in use. On wash days the line is simply pulled out and hooked on the other side of the drying yard. A hand crank is provided for tightening the line after it has been hooked.

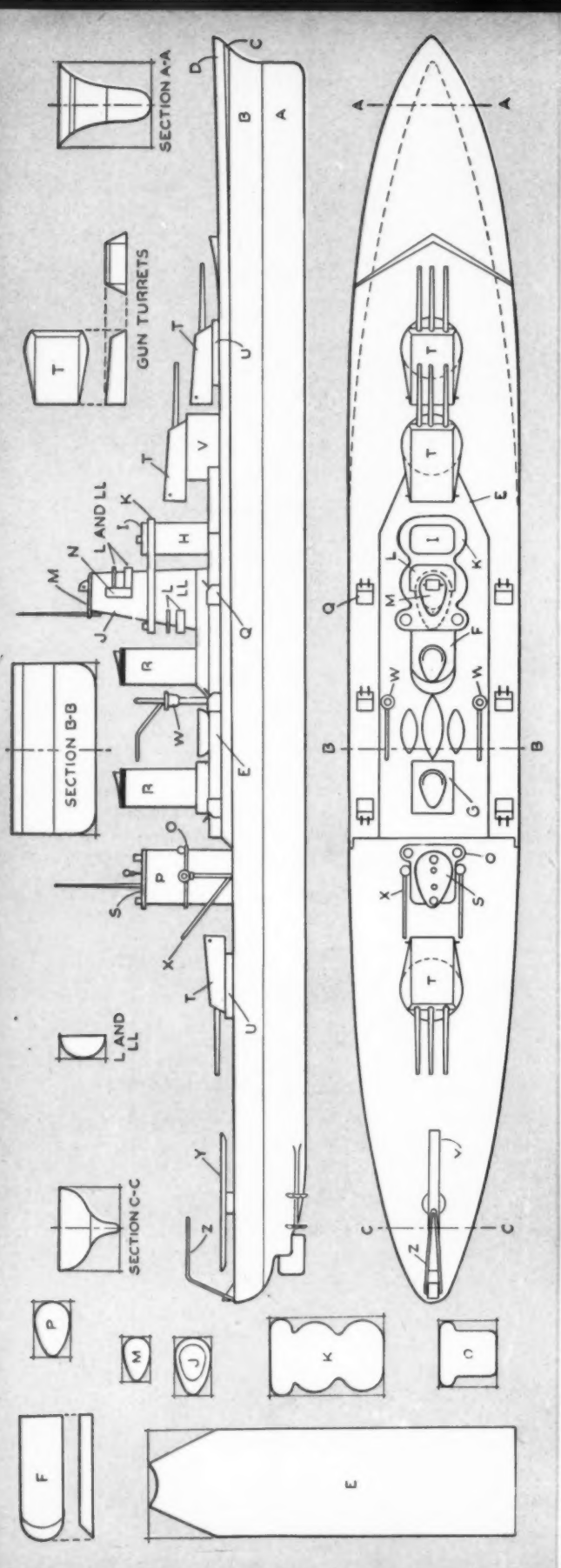
A spring phonograph motor, which provides the power, can be picked up in almost any junk yard. Remove the governor mechanism and any other parts not directly required. The remaining essentials are the main spur gear, the spring motor, and the housing. Locate a bearing plate for the winding shaft, and install the spur pinion as illustrated. On the shaft is mounted a wooden drum to carry the line, and a hand crank is required at the outside end. A ratchet from the original motor is also used on the shaft so that when the line is extended and the clothes hung, the drum remains locked. The hand crank has no other function than tightening the line.—DICK HIXON.

DRAWER CONSTRUCTION, DADO AND RABBET [*WOODWORKING*]



Get out stock for front, back, and sides. For drawers of average size, the front may be ¾" thick, the other pieces ½". Cut dados in sides first, then rabbets in front and back. Cut ¼" grooves in sides and front, ⅜" from lower edge, for ¼" plywood bottom. Cut the back ⅝" narrower than sides. Glue corner joints, slide in the bottom, apply clamps, and place on flat surface while drying. Glue piece of 5/16" stock to cover front, either flush or with projecting lips. Fasten bottom to back with brads.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



WE'RE FIRST AGAI

New United

WASHINGTON an

WAR-SCARE news and the armament race among the great powers have stirred up keen interest among model makers in the construction of miniature naval vessels. And of the many new ships now under construction for the United States Navy, none arouse as much curiosity as the new superdreadnoughts *Washington* and *North Carolina*.

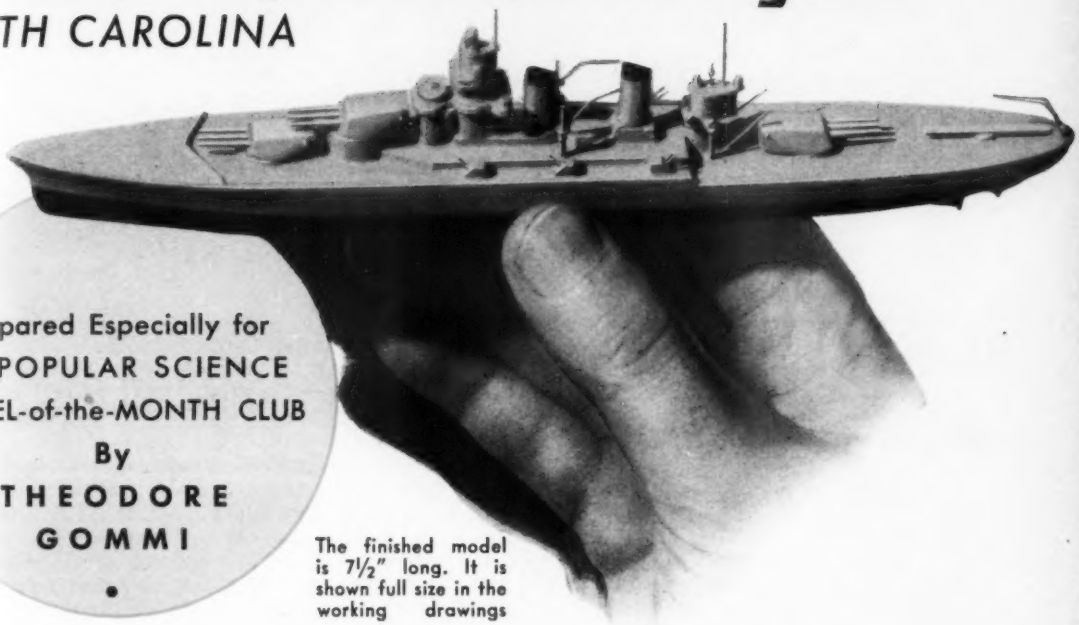
These two huge fighting craft are the first ships of the so-called "battleship class" laid down by this country since the Washington Treaty went into effect almost twenty years ago. With a length of 750′, a speed of over 28 knots, and a main armament of nine 16″ guns, they will be longer, faster, and more powerful than any of their predecessors. Bulky as they are, however, the flaring bow, long hull, and well-balanced superstructure will make them graceful vessels, while the streamlined bridge and control tower will add much to their fine appearance.

Our model is based on the present

WITH PLANS FOR MODELS OF THE

States Superdreadnoughts

NORTH CAROLINA



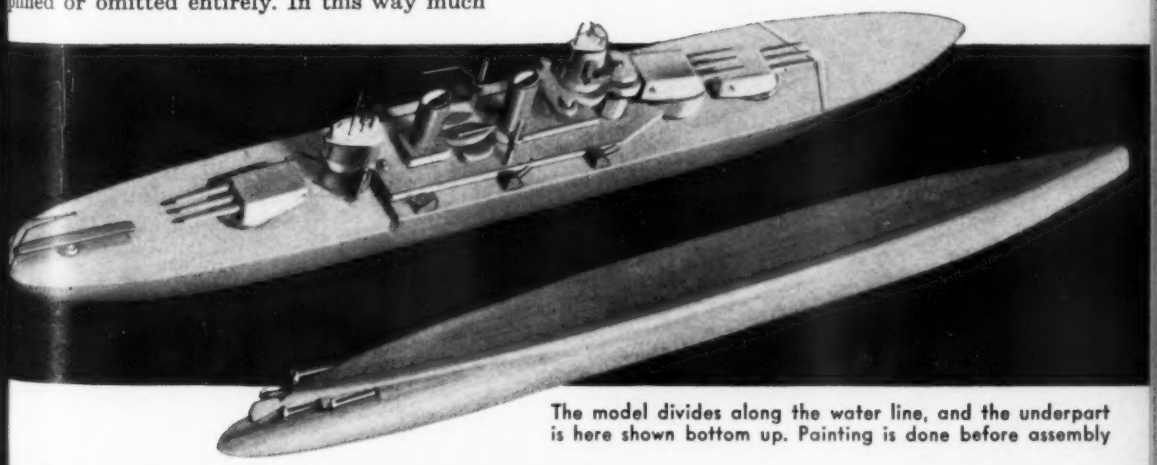
Prepared Especially for the POPULAR SCIENCE MODEL-of-the-MONTH CLUB

By

THEODORE GOMMI

The finished model is 7½" long. It is shown full size in the working drawings

plans of these sister ships. It is possible that during their construction, which will take about three years, some minor modifications will be made, but the fundamental design will not be altered. All the important characteristics are included in the model despite its small size. It is built on a scale of 1" equals 100' and is only 7½" long. The small scale was chosen so that the countless minute details of the prototype could be greatly simplified or omitted entirely. In this way much tedious and repetitious work is avoided. However, those readers who prefer a larger model can safely double all dimensions and the model will still look reasonably complete. It will also add a good deal to the realism of the project if two complete models are made, because warships never operate singly. The *Washington* and *North Carolina* will no doubt constitute a division of the battleship squadron



The model divides along the water line, and the underpart is here shown bottom up. Painting is done before assembly

when they are finally completed.

The construction is very simple. Since the drawings are reproduced full size, it is unnecessary to give dimensions. The model may be built merely from the water line up, but when made with the complete hull, it is advisable not to glue *A* and *B* together until after the painting is completed. Wooden pegs will hold these two parts together while the shaping and construction progresses. They are then separated and *A* painted black, while *B* and the superstructure are painted battleship gray.

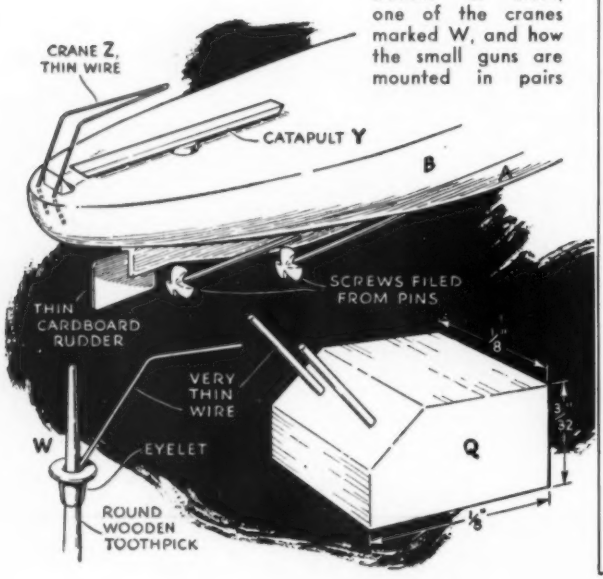
The wedge *C* gives the hull its sheer. This should be glued to *B*, together with the forecastle deck *D*, before shaping the hull. The dotted line in the plan shows the shape of *B* at the water line, while the full line shows the contour of *D* at the deck.

The heavy guns are made from the tips of ordinary round wooden toothpicks. Glue them to the turrets evenly and absolutely parallel to the center line of the ship. The range finders on the turrets are short pieces of wire. The streamlined towers should first be shaped whole, then cut to make room for the bridges *K* and *O*. The platforms *L* and *LL* are attached by first cutting slots just deep enough to hold them.

The screws or propellers are large pins with heads filed to shape. The seaplane crane is bent wire. The funnels can be made of wood, though thin aluminum or brass tubing, if available, is preferable. The rudder, smoke deflectors, and the wave-breaker on the foredeck are cut from thin cardboard or heavy paper.

A very fine drill will be found helpful for inserting masts and cranes, and for mounting guns in the small turrets.

During construction, the two parts of the hull are kept together with dowels, but they are glued when the painting has been done



Details at stern, one of the cranes marked W, and how the small guns are mounted in pairs

LIST OF MATERIALS

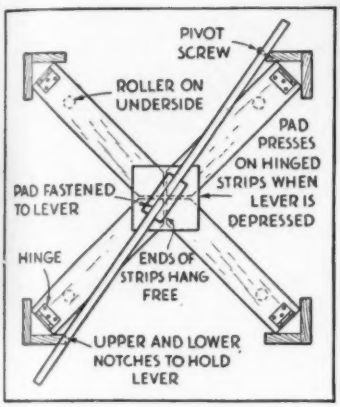
WHITE PINE, BASSWOOD, OR BALSA

No. Pc.	T.	W.	L.	For
1	¼	1	8	A, H, J, P
1	3/16	1	8	B, R, V
1	⅛	1	8	T
1	1/16	1	8	D, E, F, G, L, Q, and boats
1	1/32	1	8	C, I, N, U, K, Y

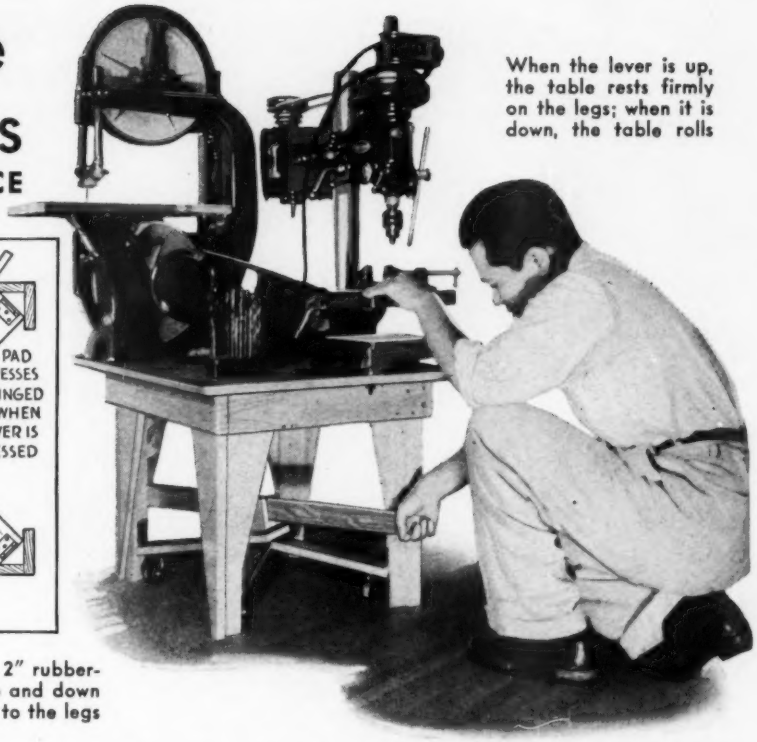
MISCELLANEOUS

11 round wooden toothpicks for W and turret guns.
6 pins about 1" long for X and screws.
2 small eyelets for W.
7 small beads for searchlights, etc.
1' thin stiff wire for cranes, masts, small guns, etc.
1 small piece of thin cardboard for LL, O, S, M, rudder, deflectors, etc.
Gray and black paint; glue or cement.

Movable Benches
SAVE SHOP SPACE


PIVOT SCREW
ROLLER ON UNDERSIDE
PAD PRESSES ON HINGED STRIPS WHEN LEVER IS DEPRESSED
PAD FASTENED TO LEVER
HINGE
ENDS OF STRIPS HANG FREE
UPPER AND LOWER NOTCHES TO HOLD LEVER

Plan view showing how the 2" rubber-tired casters are moved up and down by means of pieces hinged to the legs



When the lever is up, the table rests firmly on the legs; when it is down, the table rolls

ALTHOUGH my home workshop is only 9′ by 12′, it houses equipment that would tax the capacity of many shops twice as large. The secret lies in the manner in which the principal power tools are mounted.

The drill press and band saw are placed on opposite corners of a square, box-leg table equipped with a system of rollers, which can be easily raised or lowered. When the lever is in the upper notch, the table rests solidly on its own four legs, but as soon as the lever is pressed down and caught in the lower notch, the legs are lifted from the floor and the weight rests on the 2" rubber-tired, ball-bearing rollers. In this position the table may be placed in the center of the room and turned to any convenient angle.

A similar table holds the circular saw and jointer. The lever-and-roller arrangement makes it possible to push the machines back against the wall when not in use, and jockey them around for handling long pieces. Lumber or metal longer than the room may be allowed to protrude through the window, which is equipped with a casement sash opening out, and a roll-up screen.—H.E.B.

Sandpaper Kept in Letter File

VARIOUS types and grades of sandpaper and other abrasive paper and cloth are often kept loosely in a bench drawer or on a shelf, where they quickly get mixed up. It is better to place them in brown Manila correspondence folders. Write the name and grade of the abrasive on each index tab and keep the set of folders in a pocket-type folder of stronger material with a cover flap. This method of storing the sandpaper will also serve to some extent as a protection against dampness.—DONALD A. PRICE.

Paraffin Protects Garbage Can

GARBAGE cans sometimes rust out at the bottom after a few months' use. To prolong the life of a new can, take a ten-cent cake of paraffin and melt it over the bottom and sides of the can. This will act as a rust preventive.—THERON G. CADY.

HOW TO FINISH OR REFINISH *Cedar Chests*

..and those of other woods

The rich color of red cedar is enhanced and preserved with an all-varnish finish. The first coat is thinned 50-50 with turpentine

FINISHING NEW RED CEDAR CHESTS

[PAINTING]

1. Use no stain whatever, but seal the exterior with one coat of high-grade four-hour floor varnish mixed with an equal quantity of pure turpentine. Brush out well.

2. Sand lightly with 6/0 paper when dry; dust off, clean with a tack rag (see "Tack Rag," P.S.M., Oct. '38, p. 187), and apply a full-body coat of floor varnish. Let dry from two days to a week.

3. Fill cracks, holes, and defects with a glazing putty of one third dry white lead, two thirds whiting, colors such as burnt sienna, French ocher, and Van Dyke brown to match the work, and a few drops of varnish, all thinned to working consistency with gold-size japan. Let dry rock hard. Sand with 6/0 water-sanding paper and water. Dry overnight.

4. Dust, use tack rag, revarnish. Let dry hard and rub carefully with pumice stone and oil. Clean off and apply a good furniture polish.

The interior of a cedar chest is always left unfinished.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

By RALPH G. WARING

BLANKET chests, clothes chests, cedar chests, hope chests—what a multitude of memories they bring to mind! Since they so often hold our treasured heirlooms or costly lace and linens, they should be well-constructed, and it is almost equally important that they be attractively and durably finished.

The accompanying specifications tell how to finish a new cedar chest and how to refinish an old chest of other woods than cedar. If an old cedar chest has to be refinished, the same instructions as for new cedar will apply, once the old finish has been removed. Conversely, a new chest of some other wood than cedar may be

finished as directed for an old chest, starting with operation No. 2.

Red cedar, with its dark red knots and almost bone-white sapwood, is a very striking wood. Under no circumstances should any attempt be made to stain it to imitate other woods or to shade out the sapwood to match the heartwood.

The natural cedar oil in the wood is a powerful solvent for gums and resins, and many types of sealers have been tried. In the accompanying specifications, it will be noted that the seal coat is a mixture of high-grade four-hour floor varnish with an equal amount of turpentine. This recommendation is based on tests made on large panels and exposed for ten years. The results were overwhelmingly in favor of using nothing but varnish as a finish on red cedar.

The glazing putty mentioned in the specifications should be worked out well on a sheet of glass or tin and then forced into place with a flexible glazing putty knife. Since this is done over the first full-bodied coat of varnish, the color matching can be very exact. Any excess putty balls can be kept indefinitely for future use in a glass jar under water.

When the filled spots have hardened and are being water-sanded, inspect them frequently "under water" by looking through a small puddle of clear water. This method will show up all imperfections.

If chest straps and other trim interfere with rubbing down, use eggshell varnish instead of gloss varnish for the final coat and omit the rubbing. The straps and other metal trim should be cleaned very carefully with steel wool, dusted off, inspected, and coated with bronze lacquer of the color known as "brushed brass." If it is applied with a soft bear or fitch brush, one coat will be sufficient. When a spray gun is available, mask the straps with paper and tape, then spray the metal with bronze in lacquer or in a superior grade of bronzing liquid. In general, it is sufficient to add one teaspoon of bronze to each two tablespoons of bronzing liquid. When this is dry, pull off the masks and inspect for any necessary touching up.

In restoring the beauty of old cedar chests, the first step is to strip off the finish with steel wool and denatured alcohol

REFINISHING OLD CHESTS OTHER THAN CEDAR [*PAINTING*]

1. Remove metal trimmings and make any necessary repairs. Strip off varnish with No. 2 steel wool and denatured alcohol applied with burlap. Wash with clean alcohol and fresh rags. Sand with 4/0 paper in direction of grain.

2. Apply water stain of suitable color, depending on the exterior wood.

3. Dry. Seal with varnish reduced 50-50 with turpentine.

4. Sand lightly with 6/0 paper. Revarnish, full body. When hard, apply putty glaze where needed (see "Finishing New Red Cedar Chests"). Dry hard and water-sand.

5. Tack-rag off. Varnish full body, dry hard, and resand with wet 6/0 paper.

6. Tack-rag off. Revarnish with full-body gloss or eggshell varnish.

7. Rub with pumice stone and water or oil if gloss varnish is used. Inspect. Apply trim and assemble. Clean up with oil polish.

Two-Rail Operation Adds

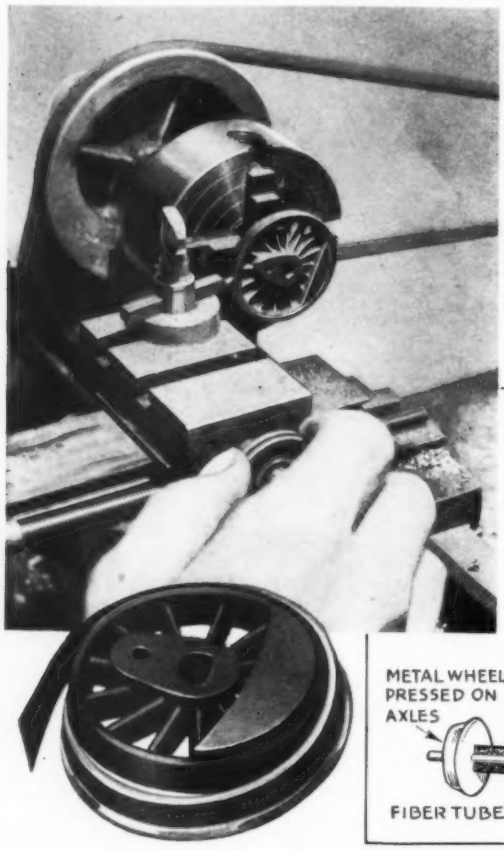
By HAROLD V. LOOSE

MOST of us are so accustomed to seeing model trains run on track having three rails that we hardly stop to think how unrealistic this is when steam-type locomotives are in operation. Electric trains *can* run on only two rails, one carrying the current to the motor and the other acting as a return. In fact, this method was used on some of the earliest electric locomotives—model and full-size. Today the idea is being revived on a scale undreamed of two or three years ago, and model railroaders of all tastes are flocking to the "new" system. It is cheaper, more realistic, and contrary to first impressions, no more complicated once the principles are understood. Unless you already have a great deal of three-rail track and equipment, it will pay you to consider these advantages when planning future extensions to your model railway track-system layout.

To change over to two-rail operation, you must insulate every wheel on every car from its mate by one of the methods shown in the drawings. Insulated wheels and trucks are readily obtainable at prices little higher than the uninsulated kind in the popular HO gauge, and, to a more limited extent, in other sizes as well. New equipment thus takes care of itself, but it is necessary to replace or alter the wheels of whatever rolling stock you already have on hand.

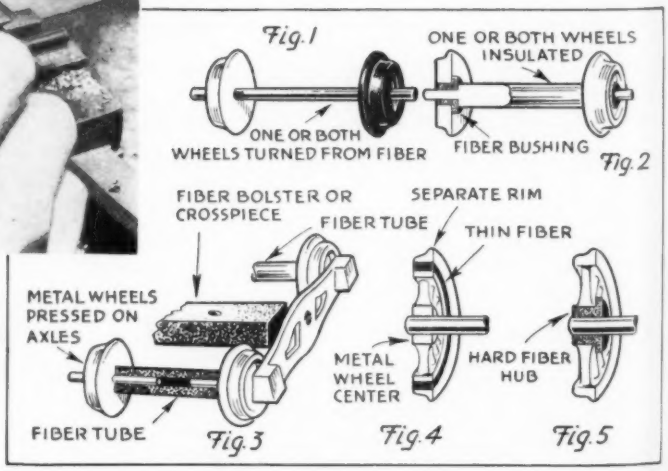
Locomotives, too, must be changed. Here the problem is more complicated because it is necessary to provide a current supply to the motors. The usual way is to insulate the wheels on only one side of the locomotives by the method suggested in Fig. 4, then to insulate the wheels on the opposite side of the tender. Connected as shown in Fig. 6, the motor picks up current from each rail.

No special insulation is needed for track*, if it is laid on wooden or cardboard ties, except at switches and crossings. Even at these

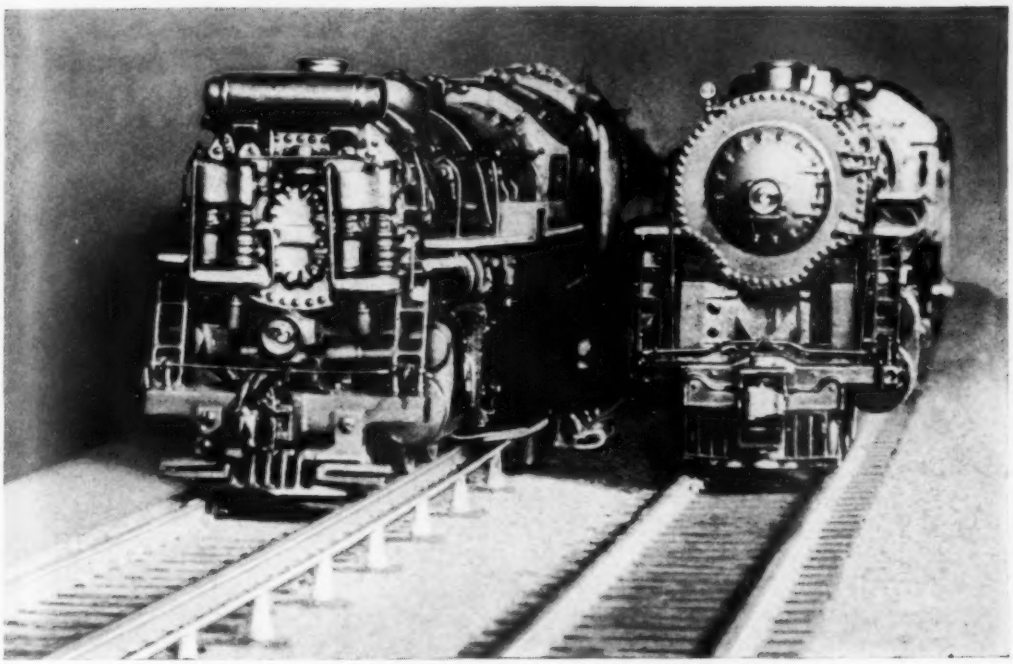


*For general information on track, layouts, control methods, equipment, and accessories, refer to "Model Railways Handbook" (Popular Science Publishing Co., Inc., New York, price $2.00).

Insulated wheel and axle; wheel is cut away to show bushing. A locomotive wheel insulated by the standard method is in the lower left corner. Above it a driver is being cut down so a new rim can slip over, with fiber between



Realism to a Model Railway



Realism of the engine on the left is spoiled by the ugly third rail. Wiring diagram for two-rail operation is given at the right

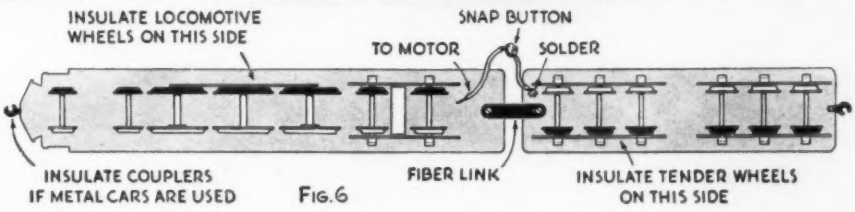
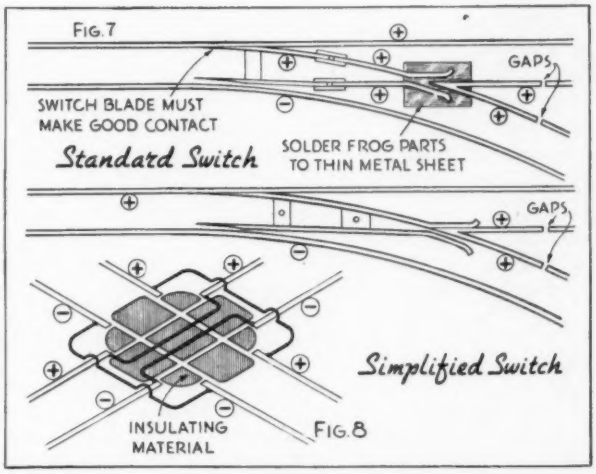


FIG. 6

points, as the drawings show, the connections are extremely simple. In a switch, it is necessary only to see that the points make good contact with the running rails when set to either side, and that gaps are provided behind the frog.

In making a crossing, the simplest way is to construct the parts at the center from nonmetallic material. Hardwood is easy to use and works perfectly, or a phenol-formaldehyde composition can be employed instead. By following the principles given in the drawing of the switch and crossing, you will be able to wire any layout, no matter how complicated. The plus (+) and minus (—) signs in the drawings indicate the polarity when a D.C. power supply is employed.



Ways to wire switches and crossings to eliminate third rail

Vases made of the material hold water for cut flowers. Left, spinning a small bowl

Pottery Mixture Gets Hard Without Being Baked

Above at left, how a piece is started from a solid ball of the mixture. At left, bowl with a simple oil-painted design

MANY home workers, like myself, have been inclined to try making pottery but have hesitated because of the cost and inconvenience of having the clay fired. Recently I did some experimenting and was able to produce pieces resembling Indian pottery that have a smooth, velvety finish and are waterproof by using the following self-hardening mixture: four parts Portland cement, three parts ordinary blue clay, obtainable almost everywhere, and two parts powdered cement waterproofing, which may be purchased at any building supply house.

The ingredients are mixed thoroughly, water is added, and the whole is kneaded as if it were bread dough. The material is then ready to be formed by hand or spun on a potter's wheel. The hands should be kept wet, and when the material cracks while being worked, it is pressed together and made smooth.

After the finished pieces have dried in the air, smooth the outside with sandpaper and apply any desired design with oil paints thinned with turpentine. Since the material is waterproof, vases and bowls may be used for holding cut flowers.—DICK HUTCHINSON.

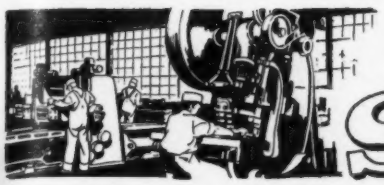
Old Toothbrush Cleans Combs

ALTHOUGH many types of comb cleaners have been invented, a discarded toothbrush serves the purpose very well after it has been washed clean and rinsed in an antiseptic solution.—C. NYE.

Now Ready—The Home Workshop Annual Index for 1938

IF YOU keep a file of back copies of POPULAR SCIENCE MONTHLY, you should send at once for a copy of the Home Workshop Annual Index for 1938. During the past year nearly 600 pages were devoted to the home workshop and to such hobbies as radio, microscopy, chemistry, and astronomy. The 1938 edition of the Index—just published—lists every item. Get it and you will save yourself hours of searching through old magazines for needed information to help you in your work.

You do not have to fill out a coupon or write a letter. Merely address Popular Science Home Workshop Index, 353 Fourth Avenue, New York, and inclose ten cents together with a large return envelope addressed to yourself. There are still a few copies of the 1937 Index available at the same nominal price of ten cents. Send twenty cents if you wish the Indexes for both years.



NEW SHOP IDEAS

Air Compressor

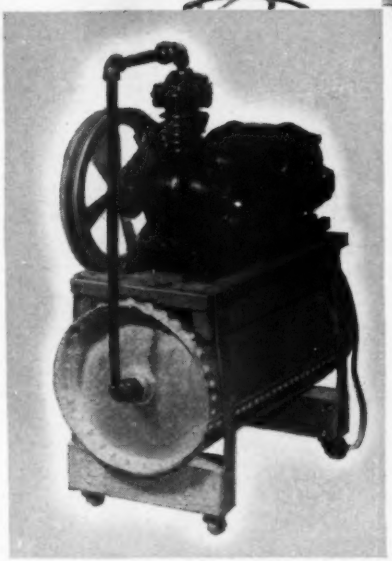
BUILT FROM JUNKED PARTS

By HAROLD P. STRAND

Assembled for less than $10, this portable outfit is run by a motor and compressor taken from an obsolete refrigerator

JUNKED materials were used almost entirely in building the efficient air compressor illustrated. Compressor and motor, taken from an obsolete type of electric refrigerator, cost five dollars. An expansion tank that had been used in a hot-water heating system was bought for two dollars from a building wrecker. A plumbing shop supplied a 200-lb. gauge for a dollar and a hand valve for thirty-five cents.

The motor required cleaning and general overhauling as described in previous articles (P. S. M., Nov. '37, p. 98, and Dec. '37, p. 96). All old oil and dirt were removed from the compressor, and the studs were sawed off at the suction and exhaust ports. At the latter, on top of the compressor, the center hole was tapped for ¼" pipe threads. The pipe was run to the tank as shown, and all other outlets in the tank were plugged except one for the gauge at the side and one at the end for the hand valve. The suction port at the side of the compressor was left open to admit air, and the plug in the base was removed to allow more air to enter by way of the valve on top of the piston.



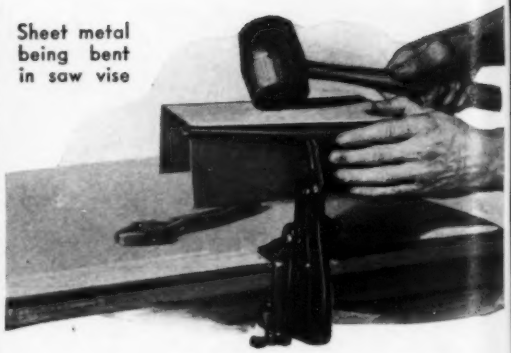
Although this compressor will pump a pressure far beyond 100 lb., it is not advisable to exceed that amount unless a new, tested tank is used. If desired, the second outlet in the side of the tank may be used for a safety valve or an automatic pressure switch to control the starting and stopping of the motor. A trap to catch oil or water may also be installed next to the hand valve, although the writer has not found that necessary as yet.

The compressor and motor are painted with black iron enamel, and the tank and lower skids, aluminum.

In case greater air capacity is required, select a two-cylinder compressor with a larger motor in place of the unit shown.

Handy Tin-Can Glue Pot

FOR preparing hot glue, a glue pot can be improvised as shown from a coffee can or other fairly large can for holding the water and a smaller can that can be suspended inside it by means of a wire. The wire serves as a handle for carrying the inner can with the melted glue and also as a strike wire for wiping any surplus glue neatly and easily off the brush or paddle.—J. J. EDWARDS.



Sheet metal being bent in saw vise

Light Sheet Metal Bent by Using Saw Vise

OCCASIONAL jobs of sheet-metal forming may be done with the aid of a saw vise as shown above. The great depth of throat, combined with the comparatively wide clamping surface, makes this type of vise especially suitable. The usual saw vise is sturdy enough to stand up under light work without injury provided reasonable care is used—W. W.

Driving Small Nails into Plaster

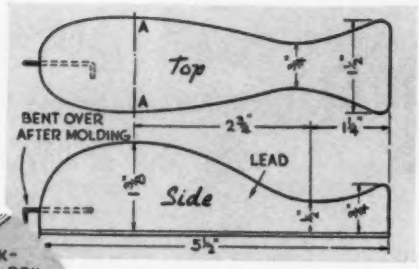
SMALL nails may be driven into plaster with less danger of marring the wall if they are first dipped in hot paraffin.—J.C.W.

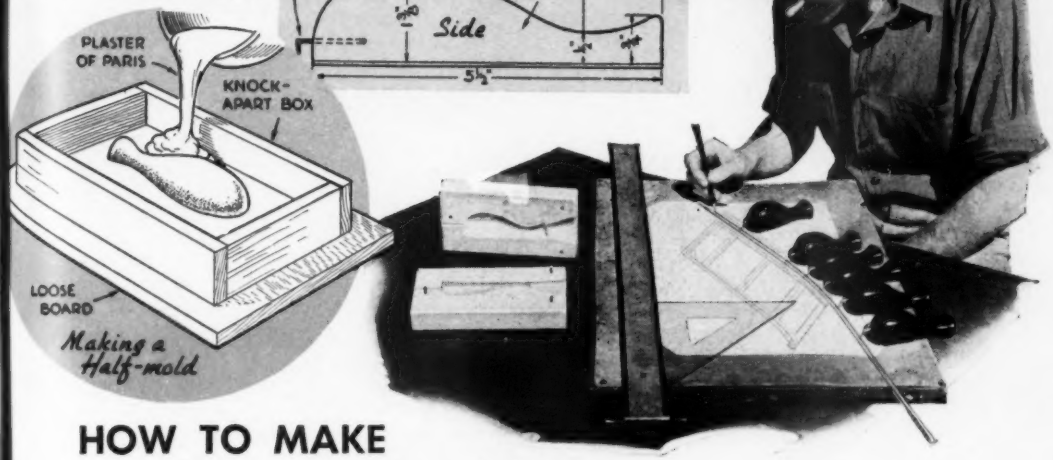
Slanting Partitions Divide Drawers for Shop Use

SHALLOW sectional drawers for shop use are more convenient to use if the partitions and sides are made with triangular pieces so the sections will have sloping sides. Drawers with long, narrow sections can be made with the sides of the sections sloping and the ends straight as at the right, but where the drawers are to hold small nails, screws, and the like, all four sides should be sloped as shown below to avoid having to pick anything out of awkward corners.—M.T.

Drawers with narrow sections are divided as shown above, other drawers as at the left

Right, shape of completed "duck." Below, pouring the plaster over one half of the clay pattern



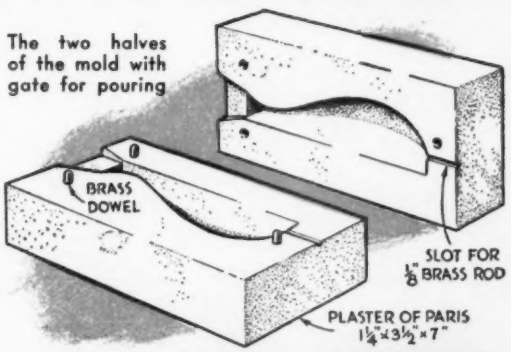


HOW TO MAKE

Lead 'Ducks' for Draftsmen

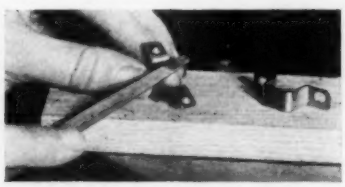
LEAD weights, called "ducks" or "whales" by draftsmen, are indispensable for holding a spline or curved ruler, but expensive to buy. To make a set, prepare a clay model and divide it down the middle (or whittle from pine). Oil the pattern, lay one side on a board, place an open box around, and pour in plaster. Make the other half mold similarly, with brass dowels for registering. When *thoroughly* dry, assemble the mold, set the brass hook in place, and pour in lead. Smooth up, paint black, and cement felt on bottom.

The two halves of the mold with gate for pouring



V-Notch in Vise Useful for Filing

WHEN the end of small rods are to be rounded with a file, they can be conveniently held stationary by placing them in a V-notch, cut or filed in the right-hand edge of the front vise jaw. As the rod is filed round, it is rotated with the fingers, thus eliminating all tiresome clamping and unclamping of the work in the vise necessary with the ordinary method.



Drilling Thin Metal Without Distortion

UNLESS clamped between blocks of wood, thin metal is difficult to drill. It can be done, however, by drilling until almost through, then turning the work over and filing off the protruding hump left by the drill.

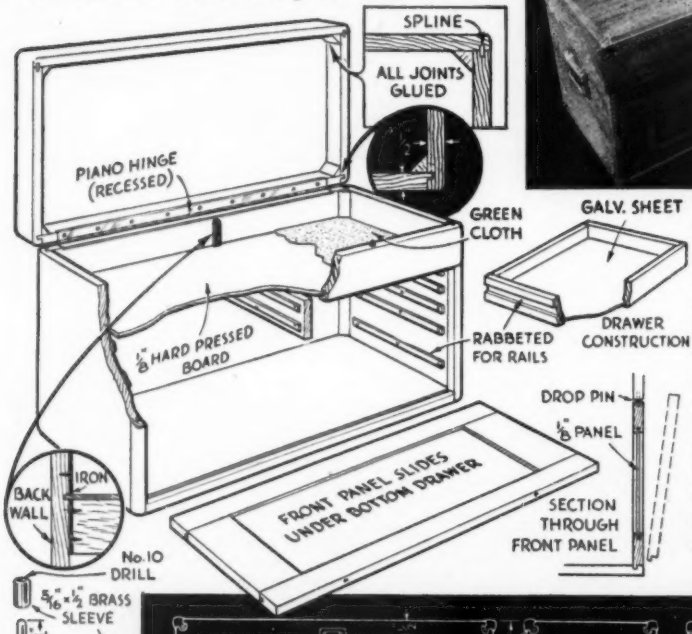
HANDSOME Sycamore Chest

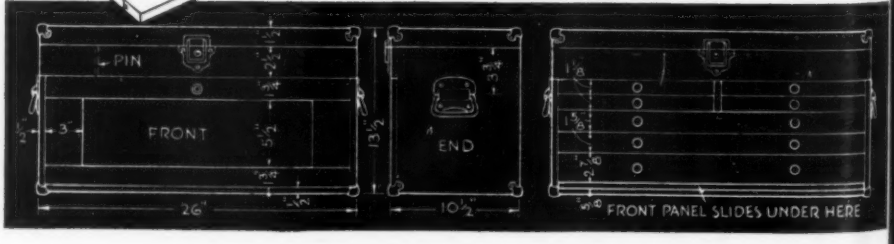
HOLDS MACHINIST'S TOOLS

AMATEUR and professional machinists who want something special in the way of a chest to hold their tools can hardly do better than copy this exceptionally fine design by Lester Hall, of Pasadena, Calif. The principal parts are made of ½" quarter-sawed sycamore, but maple, mahogany, or oak would also be suitable. Spline, tongue-and-groove, and rabbeted joints are variously used, as indicated, and held with waterproof casein glue.

Note that the front panel lifts out entirely and can be slid under the bottom drawer. When the panel is set in place to close the drawer compartment and the lid is shut down, two pins in the top rail are forced into holes in the top edge of the panel, locking it securely. As soon as the lid is raised, springs force the pins up out of the panel so it may be lifted out. Each drawer bottom is covered with green cloth so the various precision tools rest on a soft surface. Metal corners add to the attractiveness of the chest.—HI SIBLEY.

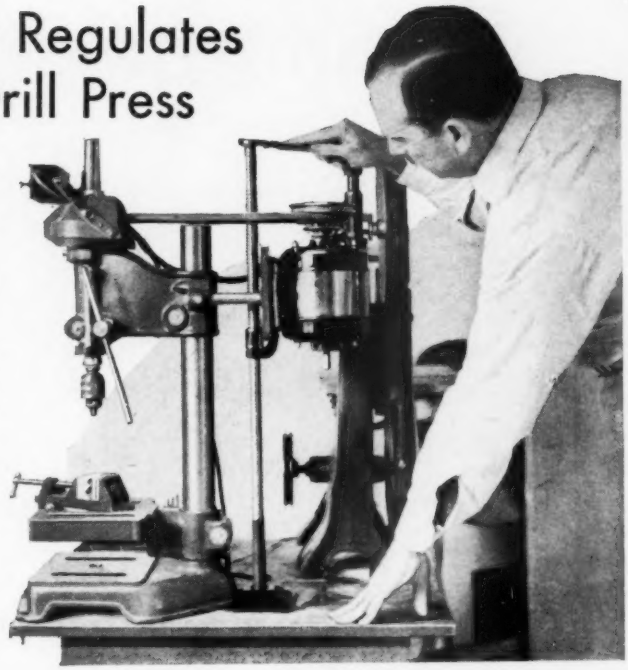
Raising the lid unlocks the panel in front, which may then be lifted out and slid under the bottom drawer

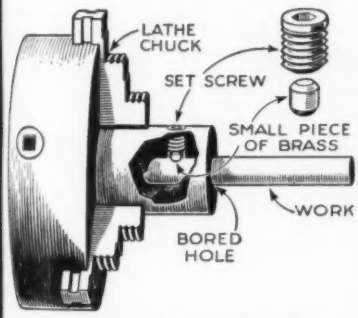




Bumper Jack Regulates Head of Drill Press

AN ORDINARY two-dollar bumper jack of the type consisting of a jackscrew, base, and ratchet wrench, makes a simple but effective screw adjustment for a drill-press head. The head may be raised or lowered with the touch of a finger, and all danger that the head will suddenly slip down the column is eliminated. It is necessary only to cut a V-shaped notch in the base plate so that the jackscrew may be set fairly close and parallel to the drill-press column. The lifting nut of the jack will engage the motor base plate of most small drill presses without alteration, and may be bolted to the base plate or left free. If the drill press is equipped with a short belt, it may be necessary to substitute a longer belt.—HENRY E. BELDEN.





Turning Accurately with Worn Chuck

VARIOUS ways to do precision turning with a worn lathe chuck have been described, but one of the best is as follows: Near the end of a piece of stock about 1" greater in diameter than the work to be turned, tap a hole halfway through for a set screw. Tighten this piece in the lathe chuck and bore a hole in it that is a slide fit for the work. Draw the work through this hole for the required length and tighten the set screw. A short piece of brass may be placed between set screw and work.—J.G.

Old Working Glove Holds Chisels

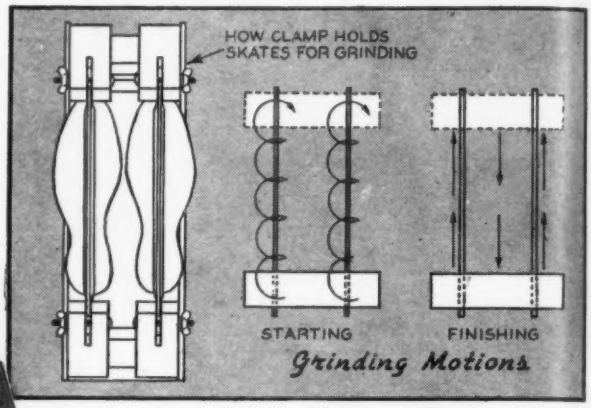
MANY carpenters keep their wood chisels and gouges in a roll of heavy canvas, with individual pockets for each tool. Those who have only occasional use for such tools, such as farmers, can give them equal protection by storing them, with cutting edge down, in the fingers of an old, oily working glove as illustrated at the right.—NORVAL WRIGHT.

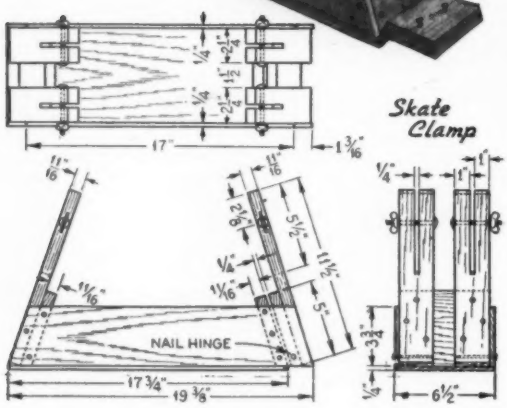
Doing Close Work with Flash Light

WHILE doing close work with a flash light, it sometimes is necessary to use both hands. If there is nothing nearby to rest the flash light on, a simple expedient is to insert it under your shirt collar. —WILLIAM SWALLOW.

Sharpening Skates

The skates are set up parallel in a wooden jig and ground true with an oilstone





BY USING a clamp made as shown, you can sharpen skates at home so that they have keen and perfectly true edges. The necessary wood for the clamp may be obtained from a discarded orange crate.

To prepare skates for sharpening, clamp one skate tightly in place, then line up the second skate as closely as possible and fasten it. Take your oilstone and draw one edge lightly across both blades. If scratches appear on the outside edge of the second skate, the skate is too low and should be raised until scratches appear all across the blade. If scratches appear the first time on the inside of the blade of the second skate, it is too high and should be lowered until repeated tests show scratches all across.

When the skates are properly aligned, a light film of oil is spread over the cutting surface of the oilstone and the grinding is done with a circular motion. As soon as a feather edge appears along the entire length of the blades, finish the grinding with a straight stroke from heel to toe. This will remove the cross scratches and give the blades a smooth, honed surface with sharp edges.—LAWRENCE SUESS.

LIST OF MATERIALS

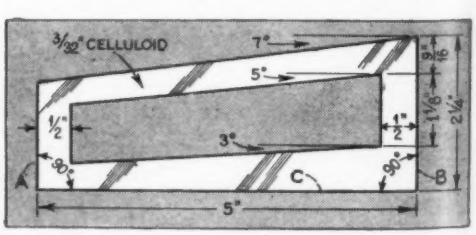
No. Pc.	Description	T.	W.	L.
4	Clamps	11/16	2¼	11½
2	Ends	11/16	5	6
1	End brace	11/16	4¾	6
2	Sides	¼	3¾	19⅜
1	Bottom	¼	6½	17¾

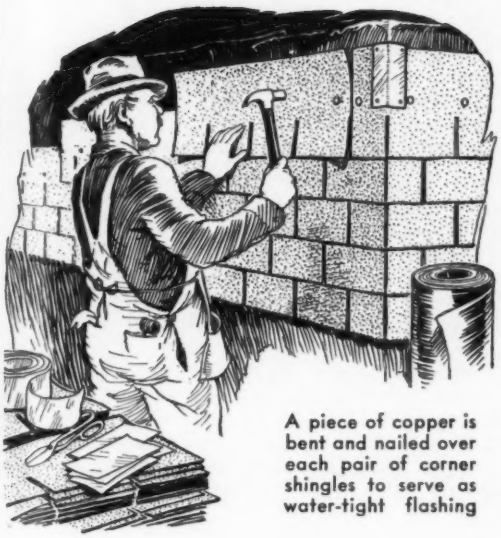
4 carriage bolts 2¾" by ¼" with washers and wing nuts

Note: All dimensions are given in inches.

Celluloid Tool Saves Time in Drawing Draft Lines

CUT from celluloid, the tool illustrated at the right will be found to save much time in drawing the so-called "draft" lines on castings and forgings. The angles indicated are the drafts generally used. Since the ends *A* and *B* are at right angles to side *C*, the tool may also be used conveniently for drawing horizontal and vertical lines like a regular triangle.—PETER F. ROSSMANN.





A piece of copper is bent and nailed over each pair of corner shingles to serve as water-tight flashing

Water-tight Corner Joint for Asphalt Shingles

WHEN amateurs attempt to apply asphalt shingles to the sides of a house, they are sometimes puzzled as to how the corners may be made water-tight. This is done by placing a small piece of copper over each pair of corner shingles as shown. If this copper flashing is long enough to lap over the piece used under the preceding layer, there is little or no possibility of water seeping in along the edge. A single long strip is sometimes bent and applied over the corner before any shingles are laid, but is not as satisfactory.

Bottle Labels Coated with Wax

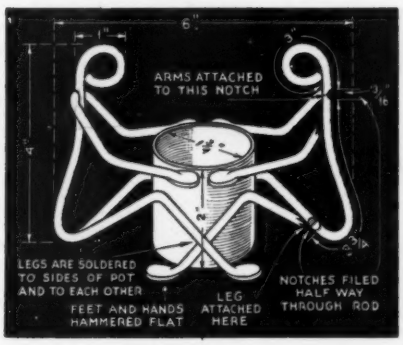
HOME chemists will find the labels of their reagent bottles will last much longer and remain legible if rubbed lightly with a common wax candle.—LOUIS FELDMAN.

Wire Cannibals Guard Pot of Cigarettes

ONLY cigarettes are contained in this miniature stewpot, but two cannibals guard it as though their lunch was within. The following materials are required: 22-gauge copper 2″ by 6″ for pot, disk of copper 1¾″ in diameter for bottom of pot, 3/16″ brass or copper rod 43″ long (4″ for leg, 11″ for head, body, and other leg, and 6½″ for arms of each cannibal).

Brass rod, which was used for the original, is rather hard when bought and has to be annealed before bending. Hold it with tongs or pliers over a gas-stove burner or in hot coals until it turns a dull red; then cool under a faucet. A small vise and a mandrel, or an anvil, is needed to bend and shape the rods properly.

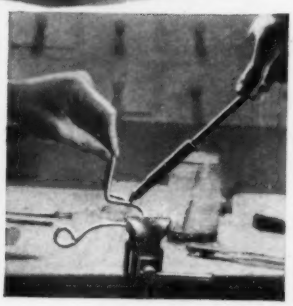
First bend the head, body, and one leg to shape. When this is done, make a similar piece for the second figure. Bend the other parts, file notches as indicated, and solder together. To make the pot, roll the piece of copper around the disk and hold in place for soldering with two pieces of soft iron wire. Solder the seam, remove the wire, clean the cannibals and pot with fine emery cloth, and then solder the figures to the pot. Apply a coat of lacquer if you want the figures to remain as bright as when you polished them.—FRANKLIN H. GOTTSHALL.


6″
ARMS ATTACHED TO THIS NOTCH
LEGS ARE SOLDERED TO SIDES OF POT AND TO EACH OTHER
FEET AND HANDS HAMMERED FLAT
LEG ATTACHED HERE
NOTCHES FILED HALF WAY THROUGH ROD

The pot is made of copper, the figures from 3/16″ brass rod. All parts are soldered together

Below, the finished holder. The stewpot will hold an entire pack of cigarettes

The two photographs below illustrate how the brass rod is bent over the horn of an anvil and how the soldering is done

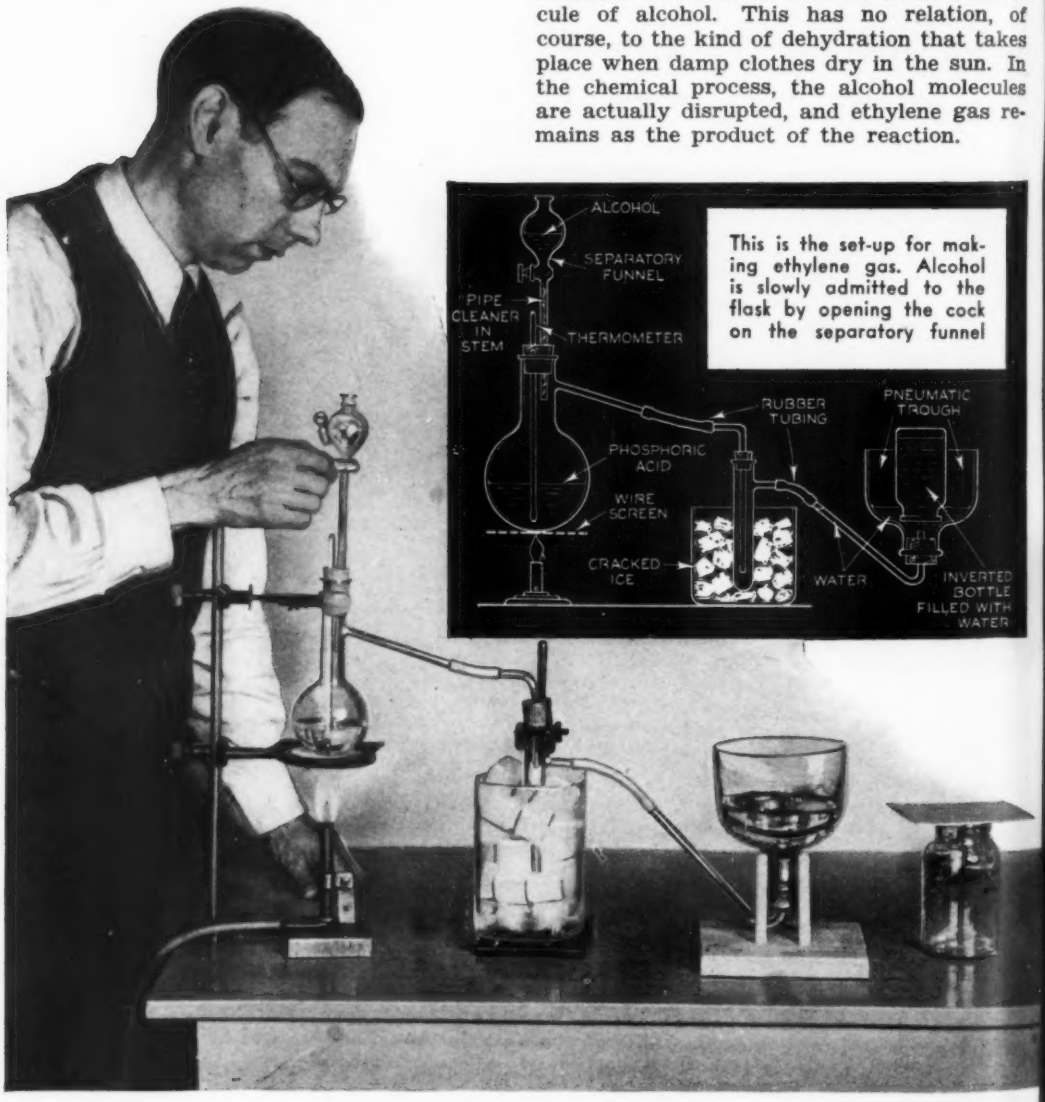


Gas Chemistry for H

PROBABLY one of your first adventures in chemistry was to make illuminating gas. Heating a little coal in a test tube, you found you could ignite the gas that distilled from it. Although you may not have known it at the time, you produced some ethylene gas in this experiment; for illuminating gas consists of hydrogen, carbon monoxide, and also various "hydrocarbons," or hydrogen-carbon compounds, including ethylene. In fact, it is the combustion of the ethylene that gives the luminous yellow color to the flame of an old-fashioned gas jet.

Ethylene has more modern practical uses. Bananas and citrous fruits are now ripened artificially, by exposure to air containing as little as one tenth of a percent of ethylene. Mixed with seven to twelve percent of oxygen, ethylene makes a valuable anesthetic.

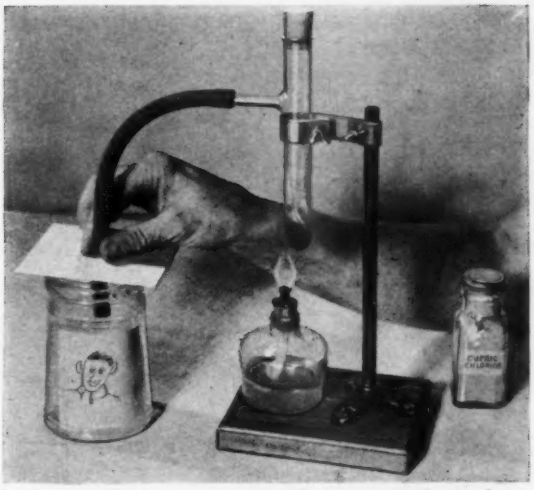
You can easily prepare this interesting gas and test some of its properties in your own home laboratory. The simplest way is to heat alcohol with sirupy phosphoric acid. A sort of chemical dehydration occurs, in which a molecule of water is removed from a molecule of alcohol. This has no relation, of course, to the kind of dehydration that takes place when damp clothes dry in the sun. In the chemical process, the alcohol molecules are actually disrupted, and ethylene gas remains as the product of the reaction.



Home Experimenters

IT'S EASY TO GENERATE ETHYLENE AND TEST ITS REMARKABLE PROPERTIES

By
RAYMOND B. WAILES

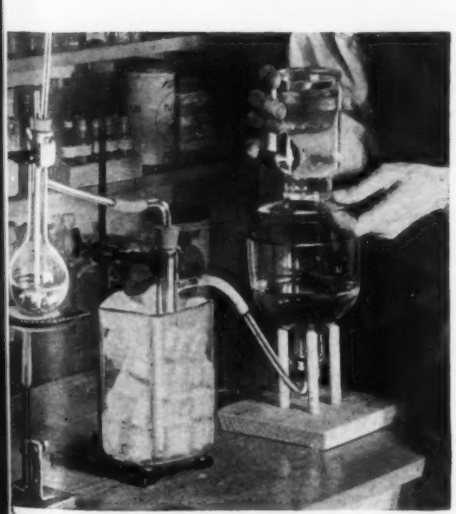


In this mystifying experiment, chlorine gas makes a drawing vanish from a piece of paper and another one appear

Ethyl or grain alcohol serves as the raw material for making ethylene. While the denaturants in radiator and rubbing alcohol might not happen to interfere in this experiment, it is preferable to use ordinary grain alcohol, which now may readily be purchased at a moderate price.

For the gas generator, use a distilling flask with a capacity of 100 to 200 cubic centimeters. Fit the flask with a cork carrying a separatory funnel and a thermometer which should fit tightly in their holes. To insure this, bore the holes a little too small—using a regular laboratory cork borer—and then enlarge them to just the right size with a rat-tail file. This is better than trying to seal leaks through oversize holes with a plastic or tape.

Connect the side arm of the distilling flask to the mouth of a side-necked test tube, which is placed in a jar of cracked ice or snow to keep it cool. The connecting piece of glass tubing should extend nearly to the bottom of the test tube, as shown in the diagram. From the side outlet of the test tube, a piece of tubing should lead to a "pneumatic trough," or device for collecting gas under water. Any kind of pneumatic trough will serve; the convenient form shown in the diagram is made from a large glass bottle with its bottom cut off, as described in one of the early articles in this series (P.S.M., May '35, p. 46).



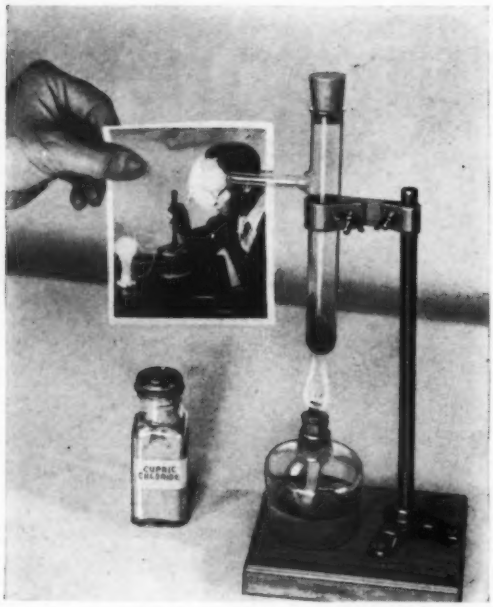
To collect ethylene prepared as shown on the opposite page, an inverted bottle full of water is lowered carefully into the pneumatic trough

Now place forty to fifty cubic centimeters, or about one and a half fluid ounces, of sirupy phosphoric acid in the distilling flask. Thrust a pipe cleaner (such as smokers use) into the stem of the separatory funnel, so that it fills the whole stem. Then fit the cork in place and adjust the thermometer so that the mercury bulb dips into the liquid. Close the stopcock of the funnel, and fill it with about fifty cubic centimeters of grain alcohol.

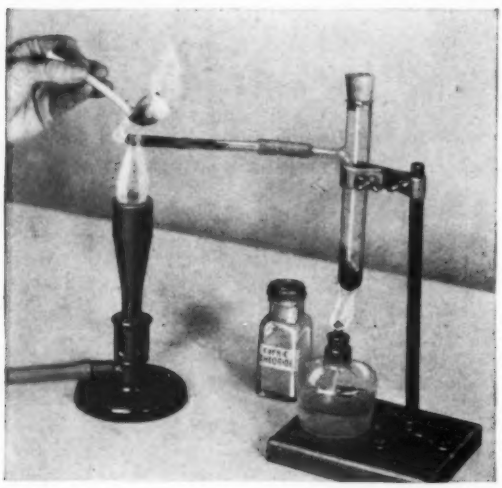
Heat the sirupy phosphoric acid in the flask. When the temperature has reached, say, 200 or 220 degrees centigrade (400 or 420 degrees, roughly, if you are using a Fahrenheit thermometer), open the stopcock of the funnel and admit alcohol to the flask drop by drop.

As the alcohol strikes the hot phosphoric acid, you will observe a brisk evolution of ethylene gas. The pipe cleaner prevents the funnel stem from filling with alcohol and then emptying into the flask in a sudden stream, which would generate ethylene gas so rapidly as to cause an undue rise of pressure in the apparatus.

From the distilling flask, the ethylene gas



Chlorine gas bleaches a photographic print by turning the black particles of silver to silver chloride



With this simple apparatus, you can deposit a coating of metallic copper on the bowl of a clay pipe

passes to the chilled, side-necked test tube. This "ice trap" condenses any impurities, such as water and alcohol vapors. The purified ethylene then goes to the pneumatic trough to be collected in bottles. At first the ethylene will be greatly diluted with air from the apparatus, but the air will be swept out and richer samples of ethylene will be delivered as you continue to add alcohol to the acid. Several bottles of the gas should now be collected for your tests.

To do this, fill a wide-mouthed bottle with water and invert it in the trough, so that its mouth will be under water and above the gas delivery tube. Covering the bottle with a watch glass will keep it from spilling while you set it in place. When it is full of ethylene gas, remove it and cover it temporarily with a watch glass or square of cardboard to await your use.

To show that ethylene is a combustible gas, remove the temporary cover of one of the bottles and insert a flaming string or broom straw. The gas will burn brilliantly. Like other combustible gases, it forms an explosive mixture with oxygen or air. Therefore this burning experiment should always be performed in a bottle with a wide mouth, which will provide for the sudden expansion in case a considerable amount of air is mixed with the ethylene.

Two parts of carbon and four parts of hydrogen go into the ethylene molecule. You might suspect that one of its products of combustion would be carbon dioxide, and you can easily prove that this is so. Add some clear, filtered limewater to the bottle in which you have just burned ethylene gas. Close the bottle and shake it. The carbon dioxide will react with the limewater to form white calcium carbonate, or precipitated chalk. Water is another of the products formed when ethylene burns to completion; and soot, or free carbon, may result from imperfect combustion.

A chemist would call ethylene gas a "reducing agent"; in other words, it seeks oxygen with vigor. To show this, mix several drops of a weak (rose-colored) solution of potassium permanganate with an equal amount of dilute sulphuric acid. Pour the resulting solution into a bottleful of ethylene gas. The permanganate loses its rosy tint, being reduced by the ethylene to a colorless manganese compound.

Strong sulphuric acid absorbs ethylene gas, forming an organic compound called ethyl sulphuric acid. You can observe this absorption by fitting a bottle of ethylene gas with a two-hole stopper, carrying a separatory funnel and a bent glass tube that dips into a beakerful of water. If you admit several cubic centimeters of strong sulphuric acid through the separatory funnel, the acid will absorb some of the gas and create a partial vacuum, drawing water from the beaker up the glass tube and into the bottle. The same experiment may be performed with illuminating gas, which, as already noted, contains ethylene.

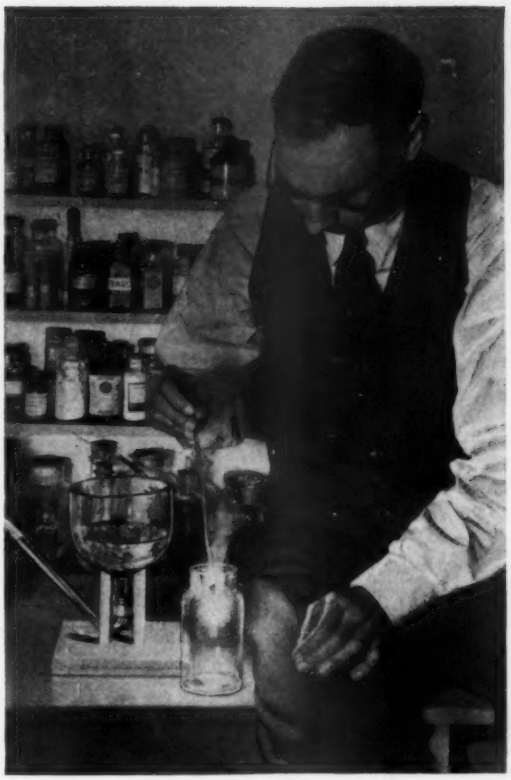
When a mixture of ethylene and chlorine is ignited, the gases react with each other to form hydrochloric acid and carbon. To see this reaction, collect about a third of a bottle of ethylene gas. Then thrust a rubber tube from a generator of chlorine gas under the partially filled bottle, while it is still in the pneumatic trough, and fill the rest with chlo-

rine. Remove the bottle, capping it momentarily, and then thrust a lighted taper into it. The mixture of gases will burn with a yellowish-colored flame. You will notice the formation of soot and the acrid odor of hydrochloric acid, the products of the reaction.

Where chlorine gas is called for in home-laboratory experiments, you may recall, previous articles of this series have advised making the tests outdoors or under a laboratory hood that will remove the noxious chlorine fumes. The ethylene-and-chlorine experiment and other interesting tests with chlorine, however, may be performed indoors without special precautions if you generate the chlorine in the following handy way. Only a small quantity of chlorine gas is produced, and this is immediately used in the experiment, so that there is little or no surplus of it to produce troublesome fumes.

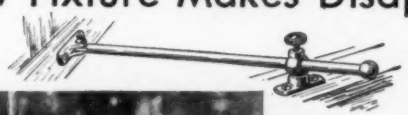
Simply place in a side-necked test tube a few grams of cupric (copper) chloride; as much as ten to fifteen grams (two to three teaspoonfuls) of the powdered greenish-blue crystals may be used for the ethylene-and-chlorine experiment, while smaller quantities will suffice for other experiments with chlorine. Cork the tube, and heat it with an alcohol lamp or a Bunsen burner. The heat will

(Continued on page 232)



Ethylene gas burns brightly when a lighted taper is thrust into a jar containing the gas

Window Fixture Makes Disappearing Ring Stand



By adjusting the set screw, the supporting rod may be set at any height, or withdrawn

A DISAPPEARING laboratory support, or ring-stand rod, will make a particularly convenient fitting for your chemical workbench or table. In use, it can't be tipped over. When you are through with it, it slides out of the way to clear the full working space of the bench for other experiments.

To make it, obtain a casement-window adjuster of the sort shown in the sketch, which may be bought for as little as a quarter. Knock out the hinge pin and discard all parts but the knurled set screw with its drilled body piece. Mount this with two screws on the side of your bench. Immediately above it, drill a hole through the bench top for the rod that it will hold. The rod may be a piece of ordinary, galvanized-iron water pipe or gas pipe, of the size rated as one-eighth inch and of any length desired. By adjusting the set screw as shown, the rod may be set at any height or withdrawn below the bench top. The device is seen in use in the photograph on page 192.

Simple Stunts Revea

Ball Balances Strangely on Current of Air

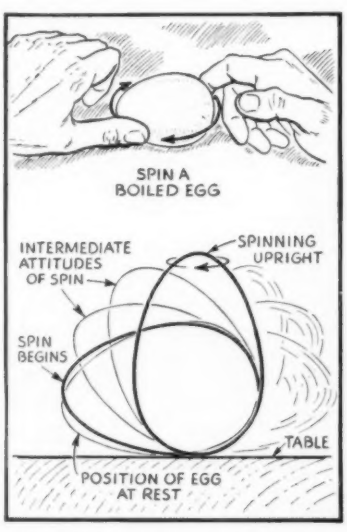
ATTACH a wire cage, holding a table-tennis ball, to the blower end of a small vacuum cleaner or hair dryer. Start the motor and hold the air tube upright. The ball may bob up and down, but remains in the center line of the cage, even when you tilt the tube as far as shown above. If it starts to fall, an opposing buoyant force is automatically produced by a low-pressure area on its upper side and a high-pressure area on its bottom.

Light Waves Measure Flatness of Glass

TO TEST the flatness of glass, press together two sheets. Use them as a mirror to view the yellow-tinted flame produced by sprinkling table salt upon an alcohol-lamp wick, or by holding the salt in a gas flame. Imperfect contact between the panes gives a double reflection of the light, and you will see black lines crossing the glass where the reflected light waves interfere with each other. The lines will be farther apart and less distorted with plate glass than with ordinary glass.

Spinning Egg Stands Up on One End

SPIN a hard-boiled egg on a table top, as illustrated. In a moment it will turn upright and revolve on one end. The twirl that you give the egg spins it on a point to one side of its center of gravity, giving the egg an added rolling motion about its long axis. The combination of the spin and the roll produces a gyroscopic action that makes the egg stand on end, as illustrated at the right.



How the spinning egg stands up on end. Rotation in two directions at once produces a gyroscopic action

Test Shows Candle Is Tiny Gas Plant

FROM a height of two to seven inches, a match flame will jump back and relight a candle that has just been put out. This shows that what burns in a candle flame is really a combustible gas formed from the wax by heat.

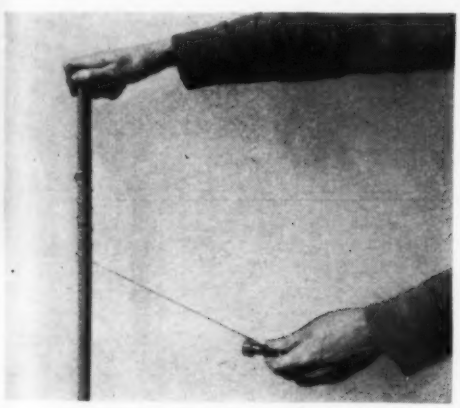
Nature's Laws

A Table Is Your Laboratory for Seven Mystifying Tests of Scientific Principles

• • •

The Farther It Winds, the Faster It Goes

ATTACH a small weight to a broomstick with a string or thread, and start it whirling as shown below. As the string winds up, the weight races faster and faster around the stick. A physicist would say that its decreasing moment of inertia is responsible. In much the same way, the winds in tornadoes and hurricanes reach enormous velocities as they approach the center of the storm.



Balance Tipped by Weight of Invisible Vapor

MAKE two paper boxes and mount them on strips of cardboard. Balance them on a pencil supported by a pile of books, as illustrated above. Place a few drops of carbon tetrachloride, a common noninflammable cleaning fluid, in a tumbler. Allow a few seconds for some vapor to form, and then tilt the glass over one of the boxes, exactly as if you were pouring some tangible fluid. Although invisible, the heavy vapor that flows into the box will swing this side downward. Pour some of the vapor into the other side, and the boxes will balance again. The boxes tilt because of the added weight when the carbon tetrachloride, which is about six times as heavy as air, displaces the air they contain. Carbon dioxide gas, made by mixing baking soda and vinegar in a tumbler, can be used for the same demonstration, but the effect is less pronounced.

Explaining the Colored Rings Around Sun and Moon

DUST a small quantity of lycopodium powder, obtained from a drug store, on a piece of glass. Look through the pane at a distant lamp bulb. You will see colored rings around the light, produced by a phenomenon called diffraction. The same effect accounts for colored borders encircling bright objects viewed through a mist, including the so-called "coronas" or "glories" of the sun and moon. These are caused by particles of moisture in the air. They are distinguished from the larger rings called "halos," which are produced around the sun and moon by floating ice crystals in the atmosphere.

Through a glass dusted with the powder, rings are seen around the light

Crystals of dextrose sugar in honey, as seen by polarized light. At left, a drop of honey taken from a comb is being placed on the slide for observation

YOUR MICROSCOPE SHOWS

Marvels in Common Foods

By MORTON C. WALLING

RARE jewels in a drop of honey, curious coil springs in a celery stem, delicate filaments on moldy bread—these are only a few of the wonders that your microscope will uncover for you right in the kitchen of your home. Perhaps you have always thought of the kitchen as a prosaic but necessary part of the house, from which tempting smells and appetizing foods appear at regular intervals. An exploring expedition with your magic lenses will reveal it as a place of magic and mystery, in which nature displays many of her most beautiful and fascinating creations.

Take, for instance, a comb of honey or a jar of extracted honey. Up to now you probably have considered honey as little more than a mass of liquid sweetness. With a toothpick transfer a drop of it to the center of a clean slide and press a clean cover glass over it. Examine it carefully at 100 or 150 diameters. You will find, almost invariably, a number of pollen grains. Just what kind of pollen these will be, it is difficult to predict, for scores of varieties are to be found in honey. You can spend days and weeks studying nothing but the pollen in honey; a European microscopist has written a book on the subject. Another thing you will find in honey is yeast, usually in the spore stage. For more detailed study of such objects, switch to a higher magnification.

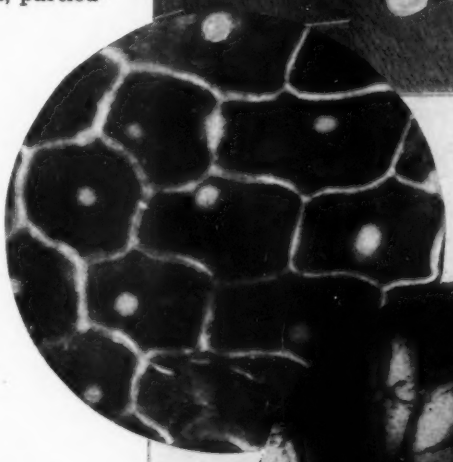
Look carefully and you may see a number of crystals, sometimes clumped together to form little clusters, and sometimes scattered about singly like stray fence pickets. If your microscope has a substage diaphragm, stopping it down will increase the visibility. Dark-field illumination is another way of rendering the crystals easily visible. Perhaps the best method of all is to employ polarized light, which makes some of the crystals appear luminous, others darker than the surrounding field, and in still others produces beautiful rainbow colors. These crystals are almost invariably composed of dextrose, which is also known as glucose or grape sugar. Honey is a solution of three sugars—dextrose, sucrose, and levulose. Dextrose forms crystals easily, sucrose rarely, and levulose not at all.

Speaking of crystals, your kitchen expedition probably will unearth some other forms in the most unexpected places. In butter, for instance. Smear a little butter on a slide and look at it at, say, 100 diameters. Unless it is a special kind of butter, you will discover a number of tiny, glasslike cubes. These are crystals of ordinary salt (sodium chloride). You can see the same kind, in great numbers, by evaporating a little salt water on a slide. Probably you will see a few crystals that are not cubical in form, too, for the salt may contain traces of iodine compounds and other chemicals.

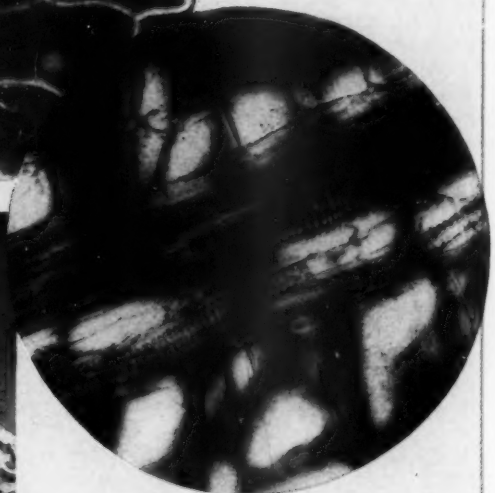
Imprisoned within the cells of many vegetable tissues, such as those of onion and various house plants including begonia and cactus, you can discover still other crystals. These are composed of either carbonate or oxalate of lime, with the latter the more common. Calcium oxalate crystals occur both singly and in clusters. You should have little difficulty in recognizing them, for they look like no other part of the plant cell. The clusters, particularly, are easy to spot, for they resemble the spike-studded ends of ancient war clubs. These crystals are, as far as botanists know, waste products of the plant, and have no usefulness to it except to provide a way of getting rid of oxalic acid and calcium.

Although yeast plants may be observed in your examination of honey, you will find it worth while to grow a few for the purpose of study. Place some compressed yeast or a yeast tablet in a glass of water sweetened with sugar or sirup, let it stand for a few days, and then examine a smear of the sediment at 400 or so diameters. It is interesting to observe yeast cells in the process of budding, the method by which they reproduce. Yeast can be found in the sediment in beer, and in fruits that have spoiled by fermentation.

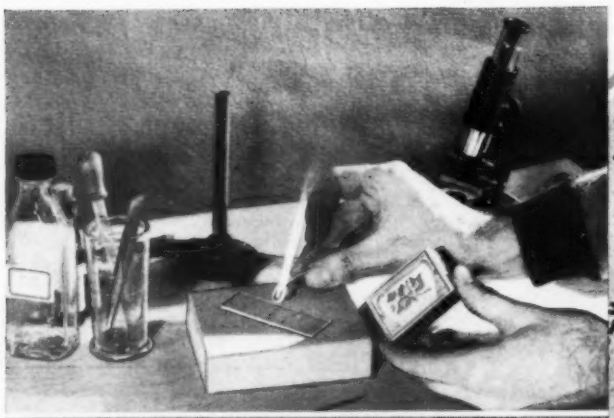
Another way in which food spoils, and incidentally produces a rich store of material

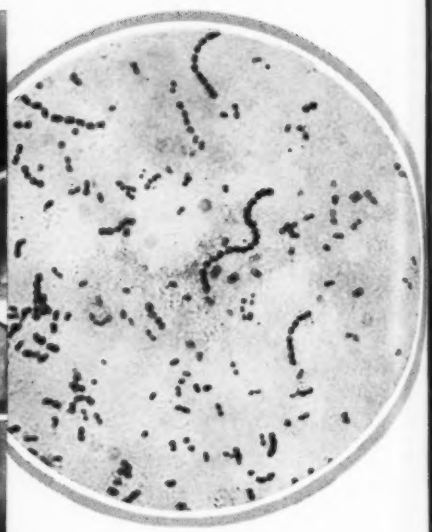


Peeling membrane from a piece of onion. Photomicrograph at left, made with dark-field illumination, shows the glasslike cells and prominent nuclei



Longitudinal section of a celery stem. Note the spiral-walled ducts that resemble tiny coil springs. Cross sections of celery and other vegetable materials can be cut easily with a kitchen knife





Bacteria in buttermilk. The picture at upper left shows how they can be "fixed" (killed and preserved). Put a little alcohol on a drop of buttermilk on a slide and then ignite it. Stain the specimen as seen at left

for the microscopist, is by molding. Molds or fungi constitute an even broader field than pollen grains, for mold spores are practically everywhere, waiting a chance to grow. If the cook has a piece of moldy bread or cake, don't let her throw it away, but take it to your microscope, lift off some of the mold filaments with tweezers, and examine them at fifty diameters or more. Watch particularly for the tiny, ball-shaped spore cases that grow on the ends of slender stalks and, when ripe, give forth myriads of dustlike spores. Many of the common molds are extremely beautiful under the microscope. And it is interesting to remember that they also can be extremely costly, for mold causes millions of dollars worth of fruit spoilage every year.

The tissues of almost every garden vegetable offer much material for the microscopist. In stems, such as those of celery, you can always discover the spiral-walled ducts that resemble tiny coil springs, as well as other features worth hours of observation. If you haven't yet seen the green chlorophyll disks in the cells of a leaf, raid the refrigerator for some lettuce or other green, leafy vegetable; or snitch a leaf from one of the potted plants in the kitchen window. Cut thin sections for mounting in water on a slide. Another kitchen vegetable that never fails to provide an interesting specimen is the lowly onion. It is easy to peel a bit of the membrane from one of the layers and spread it on a slide in a drop of water. This membrane, you will find, is composed of a neatly arranged layer of cells whose nuclei show plainly; if they do not, it is a simple matter to stain them with dilute tincture of iodine.

SIMILAR cellular arrangement can be observed in the membrane that covers an ordinary bean cotyledon, or seed leaf. Soak the bean in water for a day or so, and you can remove the bean's "shell" and separate the two cotyledons (halves). With a sharp knife or dissecting needle, remove some of the membrane from one of the cotyledons, stain it with Loeffler's methylene blue or other stain that will color vegetable cells, and you have something really beautiful. This membrane resembles, when thus prepared,

● YOU DON'T KNOW YOUR GROCERIES UNTIL YOU START

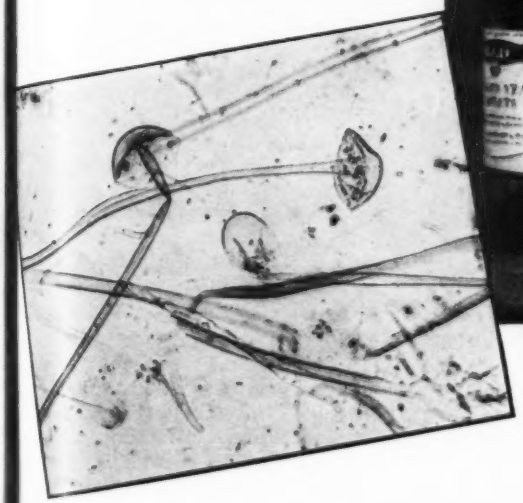
an intricate mosaic or carpet pattern; and it might serve as a design for dress goods.

In a similar way, you can separate and examine the thin membranes from other vegetables and fruits. Comparison of the cells as to shape, size, and arrangement forms another interesting study.

Seeds—poppy, celery, caraway, and even those fed to the canary that sings in the kitchen—offer another field for microscopic exploration. Because of their size, seeds can be studied at low magnifications, sometimes with a simple hand magnifier. Besides examining their surface details, you can crack or cut them open and note their internal structure. Sprout a few by placing them on damp cloth for a few days, and you can study the development of the plant. In most seeds, you can observe without difficulty the embryo plant that is lying dormant until conditions are right for its development. In the bean, for instance, you can find this plant nestled between the cotyledons, at one end. Such tiny plants are perfect and complete, and require only growth to develop into full-size specimens. The cotyledons provide food until the root system is working.

If you are interested in bacteriology, and have a microscope that magnifies 500 or so diameters with good definition, you will enjoy inspecting the kitchen bacteria. One of the best places to find them is in milk—buttermilk particularly, and also in sweet milk and in cream that has soured. You have, let us say, a quantity of buttermilk. To see the bacteria in it, you have to go through a process of slide preparation, which is not at all difficult. On a clean 1″ by 3″ slide place a small drop of buttermilk, and spread it out into a thin layer. Let it dry, and then with the slide lying level on the table, let two or three drops of alcohol (70% to absolute grain alcohol, denatured or otherwise) fall on the smear. As soon as the alcohol has spread out into a film, ignite it with a match, and let it burn to dryness. This fixes the bacteria—that is, kills them and preserves them in their natural form. To make the bacteria visible, it is necessary to stain them. This is done by letting a few drops of some stain such as Loeffler's methylene blue or a saturated alcoholic solution of methyl violet flow over the preparation. This probably will overstain, so it is necessary to rinse the preparation in alcohol, which removes excess stain and makes the bacteria stand out prominently. (If you do not have the above stains, try mercurochrome or iodine.) Rinse in water, let the preparation dry, and you are ready to examine it, either with or without a cover glass.

For a permanent preparation, simply add a drop of balsam and press a thin cover glass in place. When the milk contains fatty particles of cream, an additional step is desirable. After the smear has been fixed, immerse the slide in a jar *(Continued on page 234)*



HOW TO GROW YOUR OWN YEAST PLANTS

Drop a yeast tablet, or a piece of compressed yeast, into a glass of water sweetened with sirup. After a few days the sediment will contain yeast plants. At left, mold filaments and spore cases from stale bread

EXPLORING THE KITCHEN WITH YOUR MAGIC LENSES ●

New Aids for Radio Fans

This floor-lamp radio adds comfort to a living room. Inset shows tuning unit

Floor Lamp Has Built-In Radio

ITS tuning controls mounted within easy reach of a person seated in an armchair, a combined radio and floor lamp now available houses a complete four-tube, A.C.-D.C. receiving set in its base, and a dynamic loudspeaker at its top. Available in several color combinations, the lamp is five and a quarter feet tall, with a shade nineteen inches in diameter, and is designed to give six-way lighting. A single plug-in cord provides power for both lamp and radio.

Handy Regulator for Amplifiers

BY MEANS of the new hand-size control panel shown below, the sound volume of amplifying equipment in theaters or outdoor auditoriums may be accurately regulated by an operator sitting right in the audience where he can judge the sound from the spectator's point of view. So small that it fits in the palm of the hand, the unit is connected to the amplifying equipment by a three-wire cable that may be of any length necessary. Besides its usefulness in theaters as a permanent sound control, the unit makes a handy accessory for portable sound-amplifying equipment, to insure proper volume.

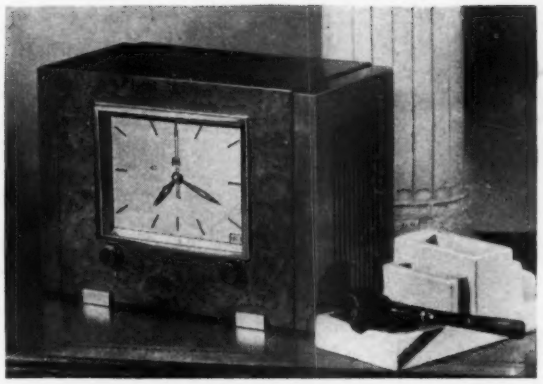
Theater or outdoor amplifiers are controlled remotely by adjusting the dial

Plug-In Control Tunes Radio Set

PLUGGED into any electric outlet in the house, the novel remote control pictured above switches the household radio on or off, selects stations, and tunes them in accurately by means of buttons and a dial. Said to work perfectly with any radio receiver, the unit requires no changes in the radio's design before operation, and the only connection to the receiver is through the house wiring.

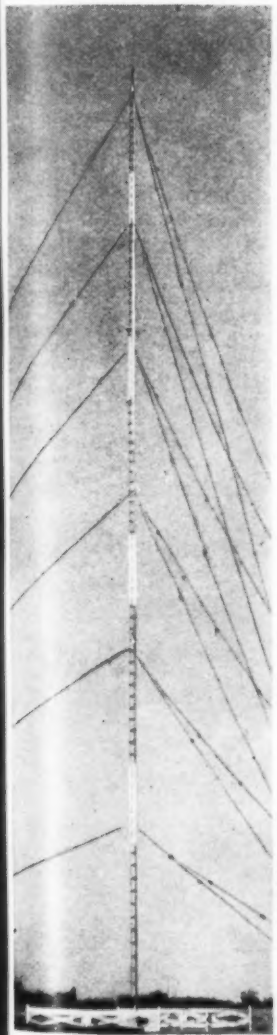
Attractive Clock-Radio Does Triple Duty

PERFORMING the duty of an alarm clock as well as a timepiece and a radio, a new clock-radio can be set to tune in any program desired at any predetermined time. Thus it may be used to wake you in the morning, or remind you of any daily duties, by automatically switching on. Looking more like a clock than a radio, the compact receiver has its tuning dial cleverly hidden in one corner of its clock face. The radio can also be made to turn itself off when a program is completed.

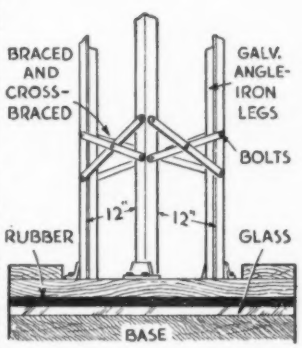


You can set this clock-radio to wake you up to music

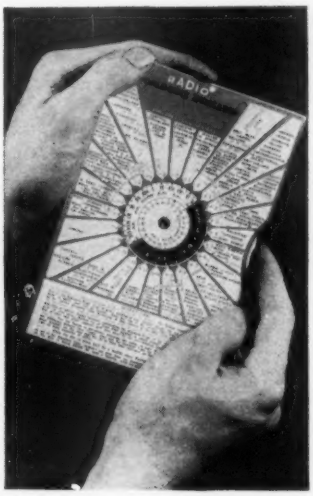
Prefabricated Masts Aid Amateurs



AVAILABLE in uniform sections which are easily bolted together, steel towers for amateurs now come in knock-down form for use with wire antennas or as modern vertical radiators. Masts up to 200 feet tall can be erected easily by three men. The tower sections consist of three side members trussed together with steel crosspieces evenly spaced. Guy wires of any desired length are available, and the tower, mounted on its pedestal of wood, rubber, and glass needs no anchorage, merely a solid footing.



How radio mast is insulated by wood, rubber, and plate glass



Adjustable Dial Tells World Time

SHORT-WAVE fans can save themselves the trouble of figuring out international times by using the handy world-time chart shown. The device, made of durable cardboard, has a revolving disk marked with A.M. and P.M. hours. Setting the disk with the time of day opposite the radial section on the card corresponding to one's own locality shows the time of day opposite other localities marked in the remaining radial sections of the card. On the back of the device is a list of principal short-wave stations of the world for the convenience of the user.

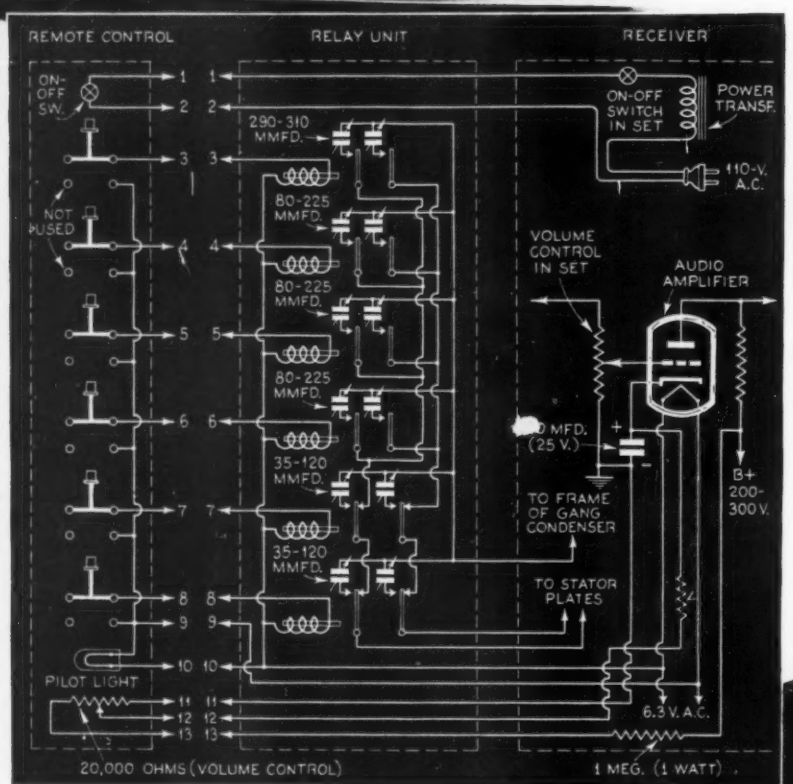
Lazy-Man's Tuner

SIMPLIFIED PUSH-BUTTON REMOTE-CONTROL

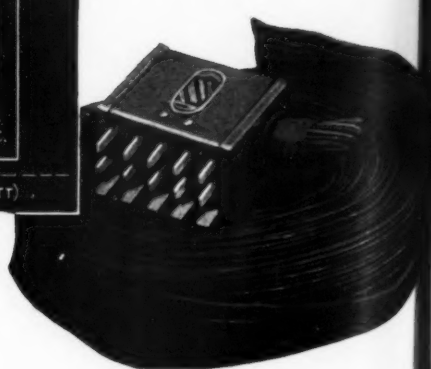
IF YOU have always wanted a simplified remote-control tuner for your broadcast receiver here is an easily built unit that needs neither motors nor expensive equipment and requires only a minimum of connections to your receiver circuit. With it, you can turn your set on or off, select any one of six stations merely by pushing a button, and control the volume; all without budging from your armchair. Provided with a long cable, the small remote-control box can be carried to any room in your house.

Basically, the unit operates by automatically connecting into the receiver preset padding condensers that tune the circuit in place of the usual tuning condenser. Operating one of the buttons on the push-button tuner switch panel in the remote-control box energizes a corresponding relay at the receiver which serves to connect the desired condensers into the circuit. In the unit shown, six tuning buttons are em-

By
HOWARD G.
McENTEE



This comprehensive diagram shows the wiring of the remote-control tuner, the relay system which tunes the radio circuit, and the receiver connections



Fits Any Broadcast Set

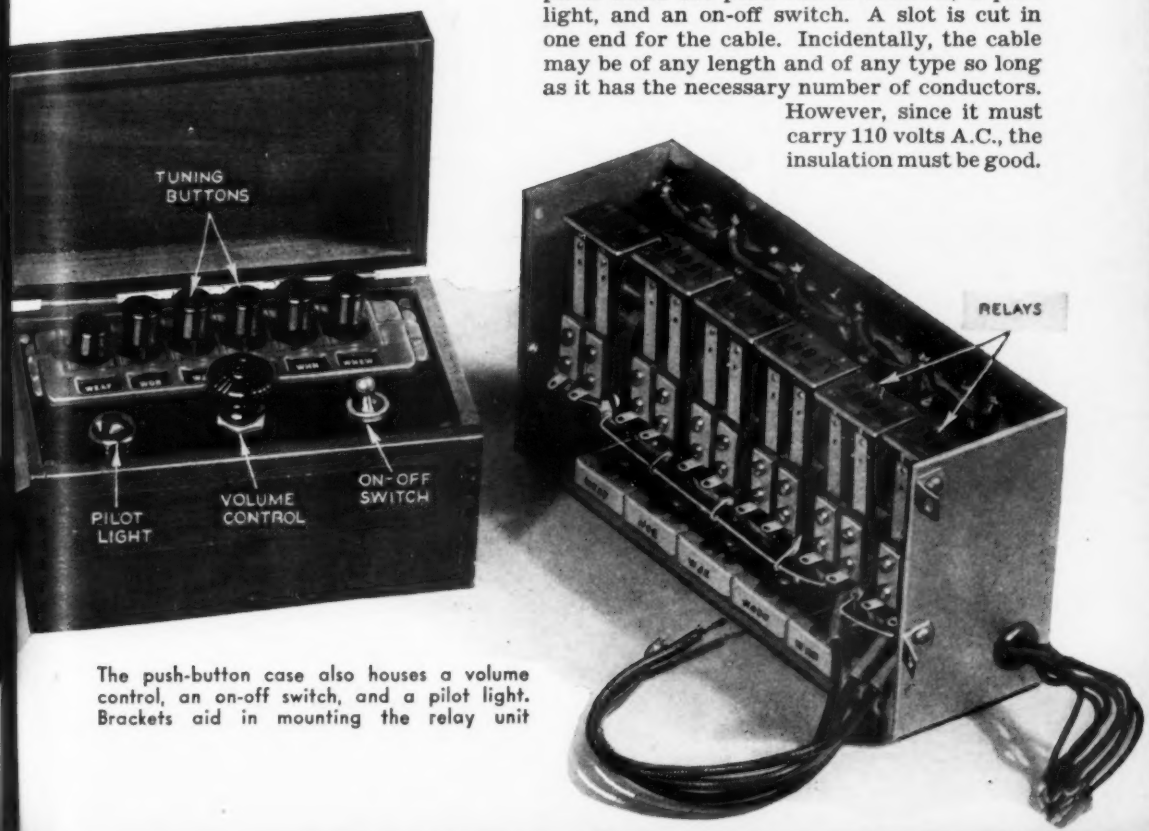
UNIT IS EASILY ASSEMBLED FROM INEXPENSIVE PARTS

ployed to operate six relays, which in turn make the condenser connections and provide a selection of six stations. Volume control is obtained by a potentiometer built into the control box.

Designed for use with the conventional broadcast superheterodyne or tuned radio-frequency set employing a two-section tuning condenser, the unit makes use of twelve padding condensers, two for each relay circuit. When a relay is operated, one of these pretuned condensers is connected across each section of the two-section condenser. In receivers employing three-section condensers, three padding condensers must be used with each circuit, and three-pole relays will be required to make the necessary connections.

The actual details of construction should not cause the set builder any great difficulty. The box for the remote-control unit is a standard wooden card-file case, 3" by 5", trimmed off until it stands 3¼" high, outside measurement. A ⅛"-thick composition panel holds the push-button controls, a pilot light, and an on-off switch. A slot is cut in one end for the cable. Incidentally, the cable may be of any length and of any type so long as it has the necessary number of conductors. However, since it must carry 110 volts A.C., the insulation must be good.

Placed beside your chair, the tuner lets you adjust your radio with ease



The push-button case also houses a volume control, an on-off switch, and a pilot light. Brackets aid in mounting the relay unit

LIST OF PARTS

One double padding condenser, 290-310 mmfd.
Two double padding condensers, 35-120 mmfd.
Three double padding condensers, 80-225 mmfd.
Electrolytic condenser, 10 mfd., 25 volt.
Variable resistor, 20,000 ohms.
Resistor, 1 watt, 1 meg.
Two relays, 6 volt, A.C., double-pole, double-throw.
Four relays, 6 volt, A.C., double-pole, single-throw.
Push-button tuning unit, six buttons.
Thirteen-wire cable.
Fifteen-connection plug and socket.
Miscellaneous:—Pilot lamp and socket, control box and panel, single-pole, single-throw toggle switch, wire, etc.

The relay unit can be fastened directly to the receiver chassis. It measures 2¼" by 3¾" by 7½". Here the six relays, controlled by the remote-control buttons, make the necessary connections between the padding condensers across each section of the receiver's tuning condenser. In this unit, the standard fifteen-connection socket for the control cable is also mounted.

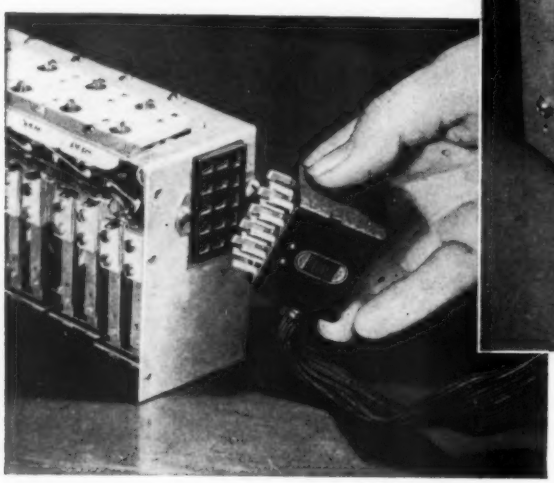
Should the cable be removed at any time, the receiver will not operate unless a wire jumper is connected between the plug terminals *11* and *12*, and *1* and *2* (see diagram).

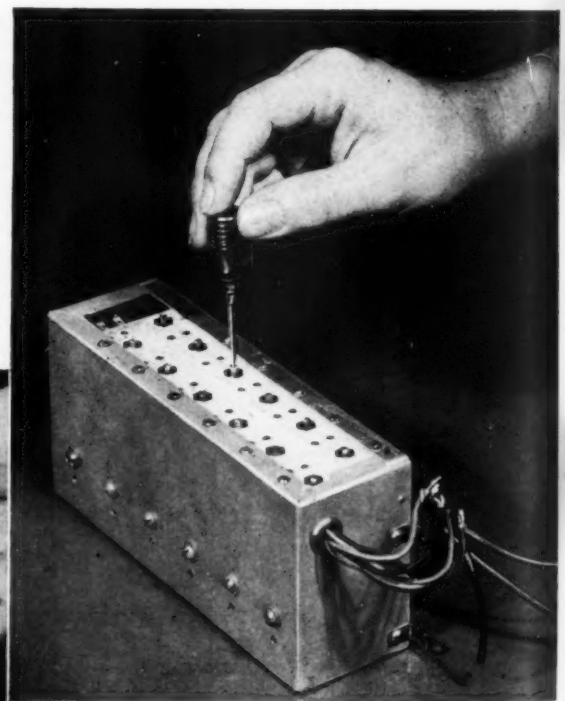
It will be noted that relays *1* and *2* have their contacts connected somewhat differently from the others. When either of these operates, all connections to the following relays are automatically opened. This is necessary to eliminate the unavoidable stray capacity in the relay connections. The four other relays may be of the double-pole, single-throw type, with contacts closed when the relay is in the "make" position.

The initial tuning of the padding condensers can be accomplished easily. They should be adjusted, section by section, until the loudest response for each desired station is obtained. Any type of tuning indicator on the receiver is a great help at this stage. The condenser values shown allow full coverage over the band.

Care must be exercised in setting the remote volume control. With the latter set at full volume, turn the receiver volume control up until the receiver output is louder than normal. Then reduce it to the desired level with the remote volume control.

When using the remote control, make sure that the receiver's tuning condenser is turned all the way out (to the high-frequency end of the dial). This procedure must, of course, also be followed during the initial tuning of the padding condensers.





In pretuning the padding condensers, they should be adjusted with a screw driver to give maximum volume on the desired stations. A multiple plug makes the relay connections

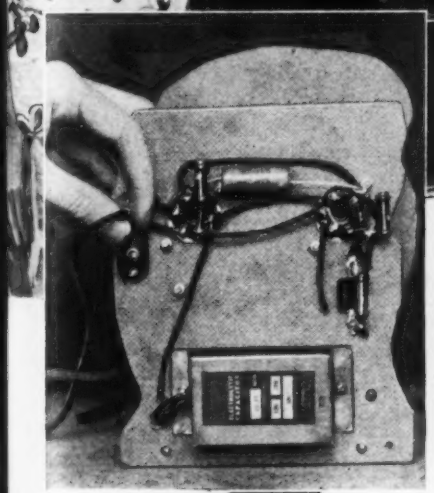
This Radio "Winks" When You Tune It

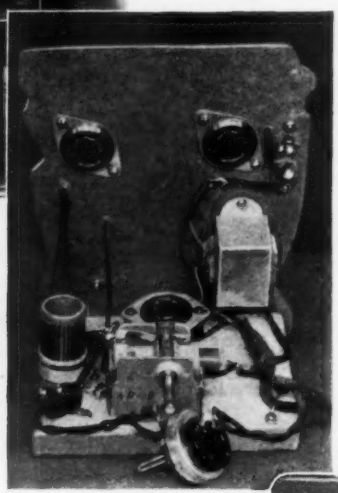
By STANLEY JOHNSON

Operating head phones, the radio is an ideal playroom set

HERE is a receiver made to order for the radio fan who enjoys something novel. The three-tube, A.C.-D.C. circuit, which uses a minimum of parts and is easy to build, features two "tuning-eye" tubes, arranged on a facelike panel and so wired that one of the "eyes" closes to give the effect of a wink when the set is tuned to a station. An ideal playroom radio, it uses headphones so it cannot disturb the rest of the household. The chassis may be installed behind any "face" panel, the odd figure shown being merely a suggestion.

The set uses one 6N5 tuning-eye tube as a regenerative detector and the second as an audio amplifier. The 6N5, a new visual-tuning-indicator tube, operates satisfactorily on the 110-volt plate voltage available in an A.C.-D.C. *(Continued on page 236)*

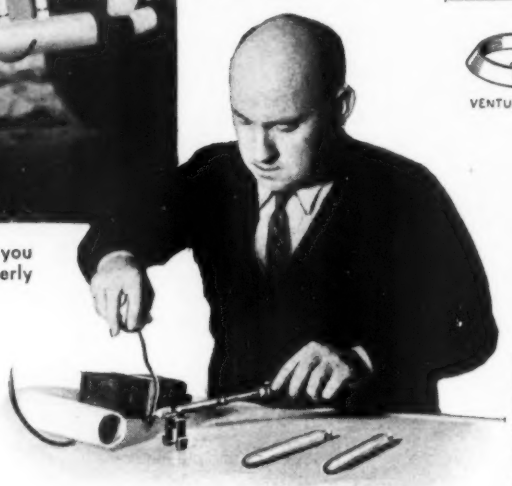


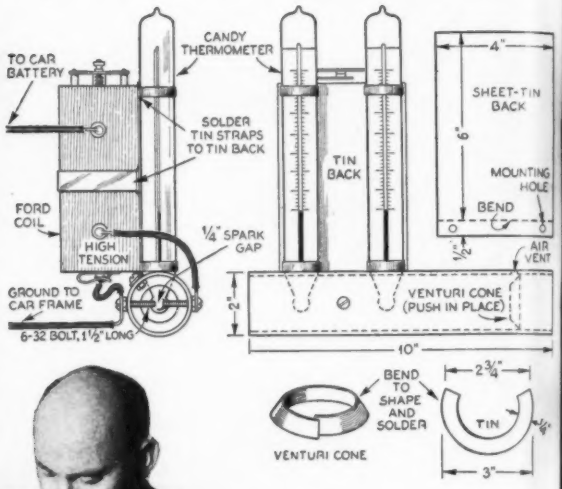


How the radio's parts are arranged on the front and back panels and the base, above. At left is the suggested panel outline. The mouth is the tuning dial, the nose the volume control. Lights from tubes at right show at the eye holes

Car-Exhaust Analyzer for Motorists

This exhaust analyzer helps you adjust your carburetor properly





How the analyzer is assembled. Solder should be used to fasten the tin straps holding the coil and thermometers

MOTORISTS who aim for good gasoline mileage are careful to adjust their carburetors, but perfect adjustment is next to impossible unless you can analyze the exhaust gases coming from your engine. For a dollar or less you can make a simple but accurate analyzer that will let you put your carburetor into whack whenever you feel that adjustments are needed.

The device makes use of the carbon monoxide gas always present in the exhaust gases of a car. Carbon monoxide burns—if it gets enough air or oxygen. The analyzer described here supplies the oxygen, ignites the monoxide with an electric spark, and compares the temperature of the burned gas with that of the unburned gas from your exhaust. Since an efficient motor gives a minimum of carbon monoxide in the exhaust, the best carburetor adjustment is obtained when the temperatures of the burned and unburned gases are nearly equal.

Parts for the simple analyzer include a piece of sheet tin, a spark coil from a Model T Ford (an automobile junk yard can supply this), a 10" length of cardboard mailing tube, two thermometers of the type used in cooking candy, which you can get at a five-and-ten-cent store, a few nuts and bolts, and wire.

The diagram above will assist you in building the device. First cut out the sheet-tin back and the venturi cone. The mailing tube, 2" in diameter, should be drilled to admit the ends of the thermometers, and to take the two 1½"-long, 6-32 bolts which form the spark gap. Insert the venturi in the mailing tube just ahead of the air vent to draw in the air. It is advisable to solder tin straps to the tin back to hold the spark coil and the thermometers.

Before using the analyzer, warm the engine thoroughly. Clamp the venturi end of the tube firmly over the exhaust pipe. Adjust the carburetor to make the mixture lean, until the engine runs unevenly. Now turn it back slowly until the engine runs smoothly and turn on the analyzer by connecting the wire to the car's battery. After ninety seconds, the rear thermometer will probably give a higher reading than the forward one. This shows that considerable carbon monoxide is present. Repeat the operations, always waiting ninety seconds before making new readings and turning off the spark between tests. When you have obtained the highest possible equal readings on the thermometers—about 130 degrees Fahrenheit—your carburetor will be in perfect adjustment.—A.K.

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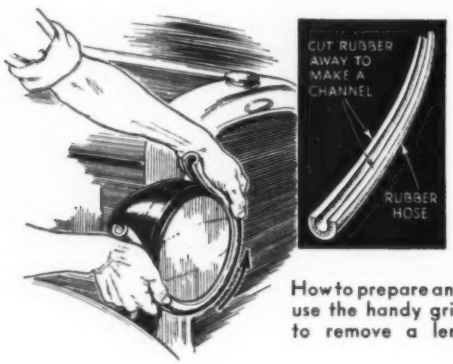
Helping a Driver To Back into a Parking Space

MOST persons who attempt to help a driver back into a crowded parking space stand on the curb and make a series of beckoning, traffic-cop gestures with their hands. A much better method, I have found, is for the helper to hold his hands approximately as far apart as the remaining distance between the backing car and the parked automobile behind, moving them together as the driver inches the car into place. In this way, the driver will be able to control his car more accurately, as he can regulate the movement with reference to the space available.—W.F.F.



How to prepare and use the handy grip to remove a lens

Hose Grips Lens Holder

HEADLIGHT-LENS holders that are hard to remove can be started easily with an old scrap of garden hose about two thirds as long as the circumference of the lens. Slice off lengthwise the top third of the hose to form a channel as shown in the inset above. Placed along the lens rim, the hose provides a safe and efficient nonslipping grip with which to turn the lens.—A.H.W.

KODAK

KODAK SENIOR SIX-20 (*f*.4.5) . . . Combination of body shutter release and eye-level finder offers new picture-making certainty . . . minimizes camera movement, catches the scene when it's exactly right. Kodak Anastigmat *f*.4.5 lens; 1/200 Kodamatic shutter. One-finger bed release. 2¼x3¼-inch pictures. **$28**

CINÉ-KODAK EIGHT

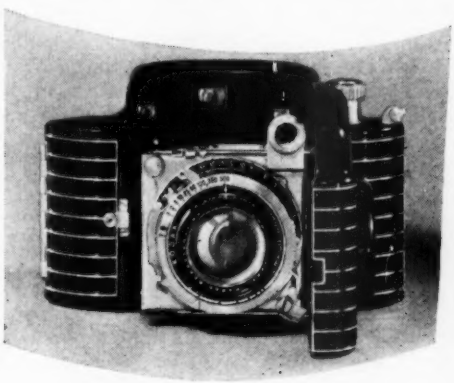
"Economy" movie camera. Gives you 20 to 30 movie scenes of newsreel length on a roll of film costing $2.25, black-and-white, *finished, ready to show.* Kodachrome (full-color) movies cost just a few cents more a scene. **$32.50**

CHRISTMAS CATALOG

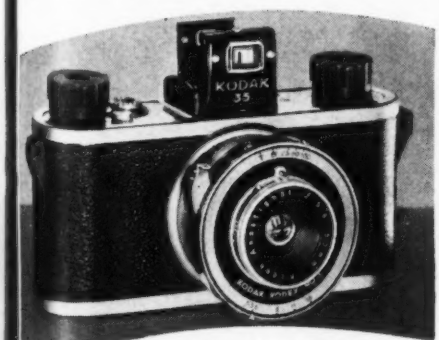
KODAK RETINA II (*left*) with anastigmat *f*.2.0 lens. 1/500 Compur-Rapid shutter. Coupled range finder. Body shutter release. Price, $140. Kodak Retina II, *f*.2.8, $115. (Prices include sportsman's field case.) Both models load with a wide range of Kodak Film, including Kodachrome for gorgeous full color. **$140**

KODAK RETINA I (*not illustrated*) . . . the original Retina, with Kodak Anastigmat EKTAR *f*.3.5 lens. Shutter, 1/500 Compur-Rapid. Film-centering mechanism. Exposure counter. **$48.50**

KODAK BANTAM SPECIAL (*right*) Lens, Kodak Anastigmat EKTAR *f*.2.0—extra-fast, super-corrected. Shutter, 1/500 Compur-Rapid. Built-in military-type range finder linked with lens mount gives hairline focus instantly. Film-centering device locks film accurately in position for each exposure. New low price includes field case. **$87.50**



KODAK BANTAM FAMILY also includes Kodak Bantam *f*.4.5 at $27.50 and Kodak Bantam *f*.5.6 at $16.50. All three models load with full-color Kodachrome Film. Lower priced Kodak Bantams, for black-and-white pictures only, include the *f*.6.3 model at $9.50 and *f*.8 model at $4.75.



NEW KODAK 35 FAMILY (*left*)

A really outstanding group of new precision miniature cameras that are priced impressively low. Fast lenses—fully corrected for color—and accurate shutters. For critical results in black-and-white, or full-color Kodachrome. Kodak 35, with *f*.5.6 lens and 1/100 Kodex shutter (*illustrated*), $18.50; with *f*.4.5 lens and 1/150 Diomatic shutter, $29.50; with Kodak Anastigmat Special *f*.3.5 lens and 1/200 Kodamatic shutter, $39.50. **$18.50**

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To the Rescue

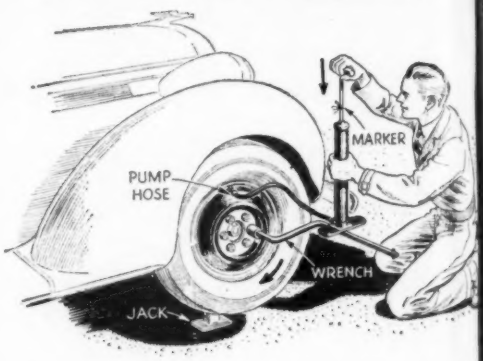
On busy days, some smokers puff so hard that their pipes, out of sheer sympathy, get pretty hot. To these men, that little carburetor in a Carburetor Kaywoodie comes to the rescue like spring water to a parched tongue. Yes, that little carburetor lets an *updraft of air* into the bowl, so that the harder you puff, the more air comes in, and instead of heating up, the smoke *stays cool*. Has brought new comfort to thousands of pipe smokers.

Shape pictured No. 71B, called DUBLIN (Long). Slightly less than actual size. Color: "Tobacco Brown," an exclusive Kaywoodie color.

Super Grain $5, Flame Grain $10, Meerschaum $15, Matched-Grain Sets $100 to $1,000.

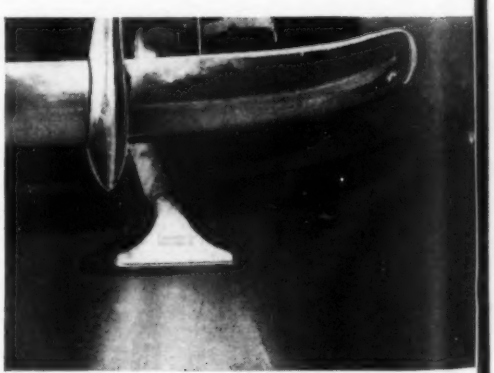
KAYWOODIE COMPANY
Rockefeller Center, NEW YORK *and* LONDON

Easy Test with Tire Pump Checks Brake Adjustment



MOTORISTS can make sure that all four brakes on a car are adjusted evenly by a simple method employing an ordinary tire pump and a piece of string. Connect the pump hose to the tire valve of a jacked-up wheel, with the base of the pump resting on a wheel wrench as shown, and press the pump handle down until the air pressure moves the wheel. Mark this spot on the pump rod with a piece of string. Then adjust the brakes on the other wheels so that the same pressure, as measured by the position of the string on the pump rod, will move each wheel.—T.W.B.

Nozzle Deflects Exhaust



Vacuum-cleaner suction head set on exhaust pipe

TO PREVENT automobile exhaust fumes from discoloring the chrome finish on the rear bumper of my car, I attached the suction head of an old vacuum cleaner to the exhaust pipe to carry away gases from the engine. Because the head is well designed for air flow, there is no danger of back pressure on the exhaust line interfering with motor operation. —A.J.K.

FISHER FACTS

ADVANCING the VALUE
of the UNISTEEL BODY *by* FISHER

AT the dawn of each new automotive year, thousands look first to the new Body by Fisher as a guide to what's what in the advancement of motoring luxury and safety.

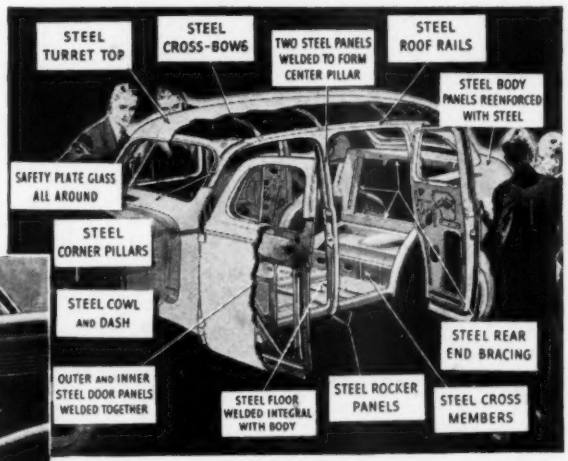
Quite naturally, this puts Fisher craftsmen face to face with an annual obligation. They can never "let well enough alone." They must be constantly improving, continually finding new ways to add new security, comforts and conveniences to the Unisteel Body by Fisher.

A SURE SIGN *to car buyers of more safety, comfort and style for their money—the famed Body by Fisher emblem marks an even greater value in 1939, stamps all of the new General Motors cars as having every advantage, both familiar and new, that the world's most famous body craftsmen have contrived.*

Just consider how faithfully they have followed this credo for 1939.

They have restyled the Unisteel Body by Fisher from cowl to tail-light with a new streamlined beauty that is now completely graceful, without one jarring note. They have enhanced the famed solid security of its Unisteel construction with more solid door supports and numerous other refinements; made its famous No Draft Ventilation even more easily controllable, and added to safety by increasing its range of visibility.

"The Smart Buy of '39"


STEEL TURRET TOP
STEEL CROSS-BOWS
TWO STEEL PANELS WELDED TO FORM CENTER PILLAR
STEEL ROOF RAILS
STEEL BODY PANELS REENFORCED WITH STEEL
SAFETY PLATE GLASS ALL AROUND
STEEL CORNER PILLARS
STEEL COWL AND DASH
STEEL REAR END BRACING
OUTER AND INNER STEEL DOOR PANELS WELDED TOGETHER
STEEL FLOOR WELDED INTEGRAL WITH BODY
STEEL ROCKER PANELS
STEEL CROSS MEMBERS

In fact, throughout—from seamless Turret Top, through sound-, heat-, and cold-proofed insulated steel panels to solid steel floor—you'll find abundant new comforts, luxuries and greater safety in the new 1939 Unisteel Body by Fisher.

So there's more reason now than ever to "pick the car with Body by Fisher." It adds a new value to all General Motors cars — the only cars that have Unisteel Turret Top Body by Fisher.

UNISTEEL TURRET TOP

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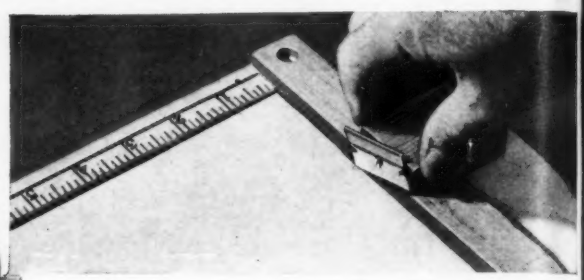
Razor-Blade Trimmer Cuts Photo Prints Accurately

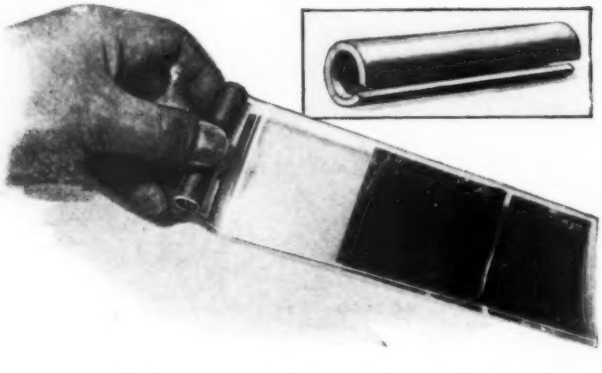


To use the trimmer, raise the cutting strip and insert the paper as at left. Replace the strip on the dowels and pull the block as shown above

PHOTOGRAPHIC prints and small sheets of paper, even if curled, can be cut accurately with the razor-blade trimmer illustrated. The board is of thick plywood with a ruler or yardstick fastened along one edge. A straight piece of ½" by 1½" wood is laid at right angles to the end of the rule, and holes are drilled through each end into the base. Short dowels are glued in the holes in the base, and project far enough to hold the drilled strip in position. A small block is then rabbeted to slide on the strip, and the razor blade is attached to the block with a screw. The size of the plywood board depends, of course, upon the work to be handled. Protect the top of the blade with a piece of metal or wood so you won't cut yourself.—K.L.R.

Slit Tubing Gives Firm Grip on Ends of Roll Film

WHEN roll films are developed in the tray by the seesaw method, the ends gripped by the fingers often become soft and slippery because of the melting of the emulsion. This can be avoided by cutting two short pieces of rubber tubing and slitting one side of each so that they will slip over the ends of the film and offer a firm grip.—C.L.



How the rubber tubes are cut, then slipped over the ends of the roll film and used as handles when developing in a tray

Glossy Photos Spotted with Grease Pencil

WHITE spots on glossy photographic enlargements may be removed by spotting them carefully with a lithographer's pencil or "grease" pencil. It is easier to use than ordinary spotting colors, and the sheen matches the gloss of the paper much better.—J.G.R.

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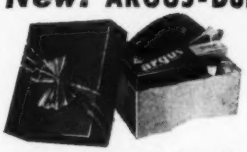

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GENERAL ELECTRIC

MAZDA PHOTO LAMPS

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A VERTICAL washer for roll films can be made for less than a dollar. For films 2¼" by 4¼" or smaller, a piece of 4⅜" by 3" galvanized down spout 46" long is suitable. A 4" by 5" piece of galvanized sheet iron is soldered to one end, and this is fastened with copper nails to a wooden base. A ¼" hole is drilled about ½" from the bottom so that a small spigot may be soldered in to serve as a drain. The intake is a short piece of copper tube soldered at an angle into a hole drilled 3¼" from the top. A weight at the bottom of the films being washed will keep them straight.—LOUIS SONKOY.

Rope Pads Hold Tripod Points

TRIPOD points can be prevented from slipping on smooth surfaces by coiling three pieces of small rope into tight spiral pads and forcing a pin through the center to hold the turns in place. Moisten the pads to make them stick to the floor.—F.B.

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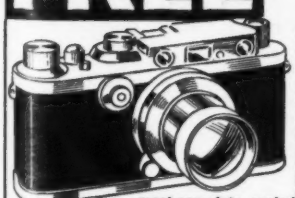

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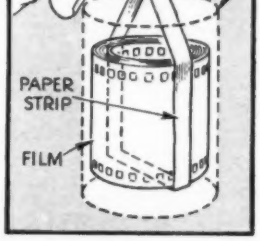
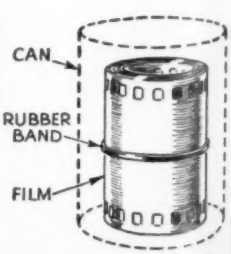
Storing Miniature Negatives in the Original Cans

A STRIP of paper ¾" by 7", if placed endwise about a roll of 35-mm. double-frame negatives, will protect them from being scratched when they are filed away in the original containers. Let the excess paper project to form a tab for lifting out the roll. Another convenient way to fill and empty the film cans is to roll the negatives tightly and bind with a rubber band. Always hold 35-mm. negatives by the edges to prevent finger prints, and never twist the roll tight because this may scratch the film's emulsion.—A. C. FLACKBERT.





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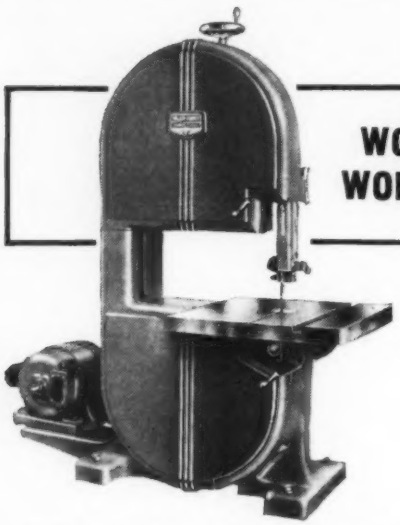

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[Construction kits are available for some of these models. Turn to page 224.]

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Combination Boat, 15' long, for sail, outboard motor, or oars, 131-132-133-R 1.00
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(Continued on page 222)

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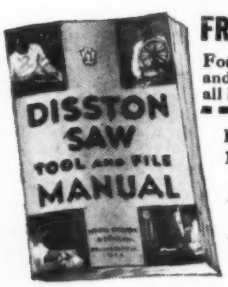

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(Continued from page 220)

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Motorboat-Rowboat, 16' long, with decked hull, for use with outboard or inboard drives and oars, 149-R ..... .50
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Utility Rowboat, 13' long; can also be sailed or driven by outboard motor, 224-R ..... .50

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Colonial Writing Desk, Governor Winthrop style, 3'6" high and 3'8" long, 21 .25
Combination Bench and Tilt-Top Table, (no turning), 11 ..... .25
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Flower Stand (38½" high) and Novel Modern Lamp, 317A ..... .25
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Kitchen Table Cabinet, 27" by 48" top, has folding seat (no turning), 27 ..... .25
Magazine Rack and Wooden Wastebasket to Match, 296A ..... .25
Modernistic Stand (24⅜" high) and Bookcase (70½" high), 88 ..... .25
Sewing Cabinet of 1812, 178A ..... .50
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Don't merely WISH for fun. HAVE GOOD TIMES! Join a motorcycle riders' club—make new friends—go places and do things! See the Harley-Davidson dealer and his 1939 models. Write for literature and FREE copy of motor cycling magazine, "The ENTHUSIAST." **Harley-Davidson Motor Co., Dept. PS-139, Milwaukee, Wis.**

HARLEY-DAVIDSON
Motorcycles

BIG NEW STREAMLINED LATHE

Swings 10" dia.

At Sensational Bargain Price

Imagine! This extra heavy wood lathe, steel bed 48" long, at low prices. Heavy duty head stock, 4-step cone pulley for V-belt. No. 2 Morse Taper Centers. Sealed ball bearings. 6" face plate screws on to spindle. Tool rest 10" long. Complete line of accessories at amazing low prices. Write today for free catalog describing Blue Star full line precision woodworking machinery. Factory-to-you prices. Not sold through agents.

BLUE STAR PRODUCTS
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BUILD THE *CUTTY SARK*

Complete Kit makes perfect lasting model **2.50** plus 15c postage

2 ft. MODEL OF THE FAMOUS CLIPPER SHIP

Everything . . including CARVED WOOD HULLS, Printed-Balsa Decks. Cast-Metal: Lifeboats, Anchors, Bitts, Steering Wheel, Chains. Masts, Spars, Rigging, Cement, Colored Lacquer — Full-Size Plans and Instructions.

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IDEAL AEROPLANE & SUPPLY COMPANY, INC.
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Vest Pocket ADDING MACHINE

IDEAL XMAS GIFT Does work of more costly machine. Counts up to million, made of steel!—weighs 8 ozs. Simple, accurate

FREE TRIAL! Not a toy. Guaranteed 5 years. **SEND NO MONEY!** Order from ad—not sold in stores. Just send name and address. On delivery, pay postman $2.50 (plus postage). If not satisfied after 10 DAYS' Trial you get your money back. **Thousands of Satisfied Users.** Write for Agents' Proposition. **Calculator Machine Co., Mfrs., P. O. Box 1118, Dept. 401, Chicago, Ill.**

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PLAY IT

LIKE AN EXPERT... WITHOUT A LESSON

Imagine! A real musical instrument swing bands use—that costs so little everybody can have one. Even if you can't read a note you should be playing the latest hits in a short time. Featured at dealers everywhere—or *order direct.* We'll mail a Tonette complete with easy instruction melody chart anywhere in the United States in time for Christmas upon receipt of $1.

TONETTE COMPANY Dept. PS-1
30 East Adams Street, Chicago

$1.00 POST PAID

TONETTE

ANYONE CAN PLAY IT!

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Use more clamps as "helps" for firmer joints, for setting-up, for accurate drilling, sawing and joining, for holding, drawing-in and lifting—you can't have too many good clamps, and "Jorgensen" and "Pony" Clamps are the very best. Those illustrated have been selected for the home work shops.

ADJUSTABLE CLAMP CO.
"The Clamp Folks"
408 N. Ashland Ave. Chicago, U. S. A.

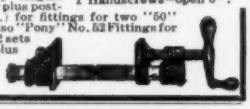
Pony Miniatures 9 types —1" to 2½" cap. Not toys but fine tools with 100 uses.

Pony "50" Fittings go on ordinary ½" pipe. Any length. Send $3.00 plus postage (6 lbs.) for fittings for two "50" Clamps. Also "Pony" No. 52 Fittings for ½" pipe—2 sets for $1.50 plus postage.

Catalog FREE

Jorgensen Handscrews

Genuine "Jorgensen" Handscrews grip at all angles, never slip, split or loosen. All sizes. Send $8.20 plus postage (7lbs.) for 2 No. 1 Handscrews—open 6".



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The Cardinal

$3.95 plus 20c post.

World's champion Bassett's new 48" gas-powered crackup-proof sensation! Finished prop., many ready-made parts, rubber wheels. Also the famous QUAKER FLASH, FLYING QUAKER and others. Also rubber-powered Giant Fliers with motor-hum device $1.00 up.

SHIPS WITH READY-CARVED HULLS . . . many ready-made parts, complete plans and materials. XEBEC (Rob. Crusoe); HISPANIOLA (Treasure Island) ARABELLA (Capt. Blood) and others, $2.00 (15c postage).

HO-GAUGE MODEL RAILROADS. Most realistic freight cars, 50c. Send 5c postage for 100-page illustrated catalog Model Kits, ready-made parts and supplies.

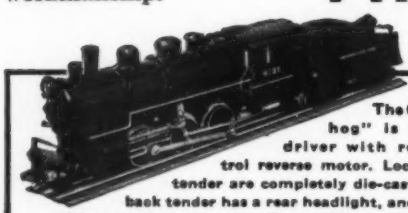
XEBEC

MEGOW'S Dept. PS—Howard & Oxf. Sts. Philadelphia, Pa.
or 217 N. Desplaines St., Chicago, Ill.

NEW MOTIVE POWER

FOR "O" GAUGE PIKES

● There are two "firsts" in the new Gilbert American Flyer line . . . the new switching locomotive and the new B. & O. "President Washington." "O" gauge men wanted them! A. C. Gilbert has built them, *just as they should be built.* Top quality in design, proportion and detail. Top quality in construction and workmanship.



The 0-6-0 "switch hog" is a powerful driver with remote-control reverse motor. Locomotive and tender are completely die-cast. The slope-back tender has a rear headlight, and is equipped with automatic couplers. Every "O" gauge pike in the country needs this new, exclusive Gilbert American Flyer unit. Price, ready to run, $12.50.

Few "O" gauge locomotives offer the true-to-life lines and proportions of the new B. & O. "President Washington." It's the 4-6-2 Pacific type, with remote control and six-wheel drive. Locomotive and tender completely die-cast. A "natural" for fast passenger and freight service. Price, ready to run, $15.

● Send for your FREE copy of the new Gilbert American Flyer Catalog. Get the latest train news right off the press.

GILBERT

AMERICAN FLYER TRAINS

MADE BY THE A. C. GILBERT COMPANY
518 Erector Square New Haven, Connecticut

Our Marionette Kit of DOPEY Makes a Unique Gift

NEED a last-minute Christmas gift? Our marionette kit is just the thing for both children and adults. They will get a lot of fun out of assembling and manipulating a marionette of Dopey, that comical little fellow in Walt Disney's animated fairy tale, "Snow White and the Seven Dwarfs." All the parts are completely finished and can be put together in half an hour or less. The price is only $2.25, but if you live west of the Mississippi River or in Canada, add 25 cents.

We also have a wide variety of construction kits containing all the necessary raw materials for making ship models and model railroad equipment. The complete list follows:

SIMPLIFIED SHIP MODEL KITS

F.	Liner S.S. MANHATTAN, 12" long	1.00
H.	Cruiser U.S.S. INDIANAPOLIS, 12" long	1.50
J.	Clipper SEA WITCH, 9½" hull, 13" over all	1.50

MODEL-OF-THE-MONTH KITS

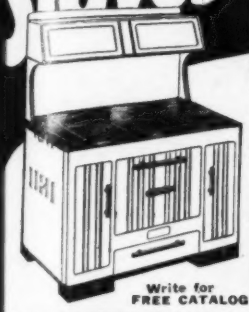
M.	Aircraft carrier SARATOGA, 18" long	$1.00
N.	Convoy of four U.S. destroyers, each 6¼" long	.75
R.	U.S. cruiser TUSCALOOSA, 11¾" long	1.00
U.	HISPANIOLA of the book and movie "Treasure Island," 7" long	.50
Z.	H.M.S. BOUNTY, 8½" hull, 11½" overall	1.50
2M.	Ocean freighter, 14" long	1.50
3M.	Yacht NOURMAHAL, 8⅛" long	1.00
4M.	Oil tanker, 14" long	1.50
5M.	Liner PRESIDENT LINCOLN, 14¾" long	1.50
6M.	Fishing Schooner WE'RE HERE of "Captains Courageous," 9½" over all	.75

STANDARD SHIP MODEL KITS

A.	Whaling ship WANDERER, 20½" hull, 27" over all	7.40*
D.	Spanish galleon, 24" hull, 30" over all	6.95*
E.	Battleship U.S.S. TEXAS, 3' long	7.45*
G.	Elizabethan galleon REVENGE, 25" hull, 28" over all	7.25*
L.	Farragut's flagship HARTFORD, steam-and-sail sloop-of-war, 33½" hull, 41" over all	8.45*
Q.	Privateer SWALLOW, a Baltimore clipper, 12½" hull, 20" over all	4.95†
V.	Clipper SOVEREIGN OF THE SEAS, 20½" hull, 26" over all	4.95†

(Continued on page 226)

Stoves AT FACTORY PRICES!



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Nearly 200 Styles and Sizes of Heaters, Ranges, Furnaces at FACTORY PRICES. Easy Terms. Write today for FREE CATALOG. New styles, new features—24-hour shipments.

Kalamazoo Stove & Furnace Co., 721 Rochester Avenue
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Over 1,300,000 Satisfied Users
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Over 7,000 GHQ Gas Engine Kits have been sold at $8.50. Now is your chance to buy the *New Improved* kit for $5.00. Absolutely complete with coil, plug, etc. 1/5 H.P. All parts guaranteed. *For boats and planes.* Send only $1. Shipped Exp. Coll. for balance same day. Catalog 3c. **DEALERS WRITE. A screwdriver is the only tool needed. Average assembly time 30 minutes.**

GHQ MOTORS, 854S East 149 St., New York, N.Y.

ONE-MAN SAWMILL

FARM MODEL $49.00

TURN TREES INTO MONEY WITH A BELSAW

Three capacities: 10, 14 and 20 ft. Accurate set works positive dogs. Hand or power feed. Runs on low power—many owners use old auto engine. *Pays for itself quickly*—thousands in commercial service, everywhere. *Write for free* lumber *handbook* and *catalog* of mills, supplies, tools, saw tables, and woodworking equipment

Belsaw Machinery Co. 846-M Davidson Bldg. Kansas City, Mo.

GET YOUR **TRACTOR AT FACTORY PRICE**

Amazing money maker for farms, truck gardens, orchards, nurseries, poultry ranches, country homes, etc. Plows, discs, harrows, cultivates, mows lawns, cuts weeds. Runs belt machinery. 2 to 6 H.P. riding or walking types. Write for **FREE CATALOG. Low Factory Prices and 10 day Trial Plan.** *Address Nearest Office.*

SHAW MFG. CO., 5701 Front St., Galesburg, Kans. 136 PS West 42nd St., New York, N.Y. 5812 PS Magnolia Ave., Chicago, Ill., 688 PS North 4th St., Columbus, O.

SHAW DU-ALL TRACTOR

WOOD CARVING and WHITTLING AN ARTISTIC HOBBY FOR ALL

This brand new manual shows you how to do every kind of wood carving. How to carve jewel boxes, picture frames, trays, chests, furniture, etc. How to do chip carving, level surface carving, incising, carving in relief. Carving human and animal figures in the round completely explained and simplified. 256 Pages. Fully illustrated,—full cloth bound. Send only $2.00 and your copy will be sent postpaid, or order COD plus postage if you wish. *Money back if not satisfied.*

Popular Science Monthly—Dept. 19
353-4th Ave. New York, N. Y.

Treet Topics

YOU'LL NEVER MISS THE DIME ~
10¢
SO WHY MISS THE COMFORT
UMMM-- NOT A SCRAPE
AND WHY MISS THE MISSES...
WHEN YOU CAN DO THIS:-
TREET BLADES!
YESSIR 4 FOR 10¢
-AND TREET YOURSELF TO A PACK OF PERFECT SHAVES!
Treet
4 FOR 10¢
Treet SINGLE EDGE BLADES
FOR GEM AND EVER-READY RAZORS

Treet Safety Razor Corporation, Newark, New Jersey

BIG MONEY!

ASSEMBLING MEAD'S

New PORTABLE KI-YAK

IN A FEW DAYS AT HOME!

—from Complete Cut-To-Fit Construction Kit!

Weigh as little as 20 LBS.

Use with PADDLE! OARS! SAIL! MOTOR!

Assemble for PROFIT or Personal FUN!

NO Experience Needed!

MEAD'S perfected, patented, *aluminum-ribbed* Cut-To-Fit Construction Kit GUARANTEES successful assembly easily, quickly, *INEXPENSIVELY*—in a few days at home with simple hand tools *without* previous experience. Build yours for *personal* sport use, or sell at *splendid* profit! Mead's *quality* KI-YAKS (available in 5 models, kits or factory assembled) are beautiful and PORTABLE. Take yours *anywhere* by hand or car for *paddling, sailing, rowing, outboarding,* touring, fishing, camping, hunting. Leak-proof. *Seaworthy.* Durable. THOUSANDS in use. Strong as a giant—light as a feather! *More* fun at *less* cost! $6.00 Double-Blade Paddle *GIVEN* with your CK Ki-Yak—*if you hurry!* Mail 10c and Coupon below for Giant Colored Circular, *special* paddle offer. Low Introductory Prices!

OK-2

Weighs only 50 lbs.

Takes ANY Outboard 4½ H. P. or less!

Carry motor in one hand—OK-2 in other!

OK-2 as rowboat

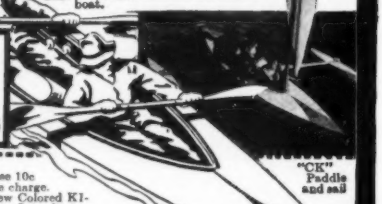
AMAZING LOW COST!

Don't buy any boat until you see the amazing Low Introductory Prices on MEAD KI-YAK Construction Kits and Factory-Built jobs. (You can even Pay As You Build, on our special Progressive Group plan!) EARN money assembling, selling! Remember, Mead KI-YAKS are *unsurpassed* . . . the lightest, strongest, most *portable* boats of their kind! Join in the FUN—and PROFITS being made. Rush Coupon and dime NOW for Free details *BEFORE prices go up!*

OK-2 as motor boat, Convertible in10 minutes into fast mail-boat.

Mail Coupon NOW!

$6 PADDLE GIVEN with your CK-KI-YAK—*if you hurry!*



"CK" Paddle and sail

Gentlemen: I enclose 10c as handling, postage charge. Please rush your New Colored KI-YAK Circular, Low Introductory Prices, and $6 Gift Paddle Offer. (Please Print Plainly.)

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RUSH ME WITH 10c TO—

MEAD GLIDERS

15 S. MARKET ST. Dept. D-19 CHICAGO, U.S.A.

Our Kits Make Fine Gifts

(Continued from page 224)

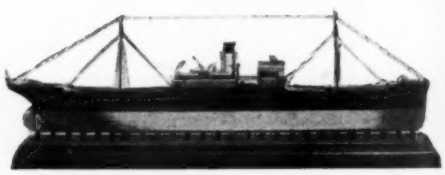
Y.	Trading schooner, Maine type; 17½" hull, 22½" over all	4.90†
2S.	U.S. Navy destroyer PRESTON, 31½" long	5.95*
3S.	CONSTITUTION ("Old Ironsides") 21" hull, 31" over all	6.50*
4S.	Clipper ship GREAT REPUBLIC, 31½" hull, 42" over all	8.40*
5S.	Coast Guard Patrol of 165-ft. type, 20⅝" long (same as President's yacht POTOMAC)	4.95*
6S.	Brig MALEK ADHEL, 20" hull, 33" over all; frame-and-plank construction	9.75†
8S.	Fishing schooner BLUENOSE, 17½" hull, 22" over all	4.95†
9S.	New Bedford whaleboat, with complete equipment, 14" long	2.75†
10S.	Confederate raider ALABAMA; steam sloop, bark rigged; 21½" hull, 28" over all	8.20*

MODEL RAILWAY KITS

1L.	HO-gauge, Hudson-type model locomotive and tender, 14" long	9.95*
2L.	Supplementary power unit for locomotive 1L; consists of 6-volt motor and worm and gear	4.50
3L.	HO-gauge track kit. Contains raw materials for making 25 ft. of track	4.00*
4L.	Deluxe track kit. Same as 3L except that kit contains third-rail chairs	6.95*

MISCELLANEOUS

4.	Solid mahogany book trough, 22½" long, 9½" wide, and 24¾" high. Ready to assemble	5.30*
5.	Solid rock maple hanging wall rack, 19½" wide, 33¼" high. Ready to assemble	5.75*



This ocean freighter is built with Kit 2M

7.	Whittling kit with two shaped blocks for making sea captain 5½" high	1.50
8.	Whittling kit for six different Scotties; each is 2" by 2¼", sawed to shape	1.00
10.	Copycraft whittling kit for making one of several Hobo Hank novelties. Includes master model 5¾" high	1.50
12.	Marionette kit for making a model of Dopey the Dwarf, 9" high. Hand-painted head and complete parts, ready to assemble	2.25†

Note: If you live west of the Mississippi River or in Canada, add 50 cents to prices marked with an asterisk (*) and 25 cents to prices marked with a dagger (†).

Popular Science Monthly, Dept. 19A
353 Fourth Avenue, New York, N. Y.

Please send me C. O. D. Kit.....

I will pay the postman the price shown above plus a few cents postage in full payment. (Canadian orders cannot be sent C. O. D.).

Name.....

Address.....

City.....State.....

(Please print your name and address very clearly)

If you prefer to send your remittance with this order, you save the C.O.D. charge. Remit by money order, check, or registered mail. This offer is made only in the United States and Canada. Also see note above.

ADVERTISING PAGES REMOVED

SQUARING operations of the semiprecision type are too often done in a surface grinder when a disk-grinding set-up would reduce the cost at least fifty percent.

. . .

When we are told that seamless steel tubing goes into the making of no less than thirty automobile parts, we know that many small machine shops are missing a bet by not using more of this labor-saving material.

. . .

Assorting scrap steel as you scrap it makes the only profitable scrap pile. There are too many scrap-pile fanatics who spend an hour or two digging out usable pieces and then brag that the material didn't cost a cent.

. . .

It takes but a few minutes to fit a brass tip to a lathe-dog screw. Results: better dogs and no dents.

. . .

A machinist friend said to me recently: "I ream considerably more and better holes with a single grind now that I keep a small oilstone in my apron pocket and touch up the chamfers occasionally."

. . .

Grind all taps to a 15-deg. three-thread chamfer if you are cutting through, but use a 33-deg. one-and-a-half-thread chamfer as much as you can for shoulder work.

. . .

A machine-shop slogan that has become popular is, "fewer tools but better ones." This means extra attention in handling, using, and servicing.

Live Electric Wire Soldered Without Danger of Shock

ALTHOUGH amateurs should never attempt it, professional electricians sometimes find it necessary to solder a joint on a live line where it is not easy to insulate themselves from the ground, as, for example, when there are no dry boards handy to stand on. In this case, break off a short length of wire solder and wrap it around the shank of a screw driver having a wood or composition handle. The end of the solder then can be touched to the joint or the soldering copper without the possibility of a shock being received through the wire solder.—ERWIN LA HAINE.

HANDEE

TOOL OF 1001 USES

Grinds
Drills
Polishes
Engraves
Sharpens
Carves
Cleans
Sands
Cuts
Saws

This Year Give HIM
A HOBBY

Men and boys of all ages satisfy their inherent urge to make scores of useful articles with the famous Handee.

A WHOLE TOOL SHOP IN YOUR HAND

This amazing tool and your choice of accessories do a multitude of jobs on all materials. Set up shop wherever there is an electric outlet. De Luxe Model weighs 12 oz. 25,000 r.p.m. $18.50 Postpaid with 6 Accessories.

ULTRA DE LUXE SET

A treasure chest. De Luxe Model and 27 popular Accessories in metal case. This practical gift will be appreciated and used for years. $25.00 postpaid. Project Book included.

STANDARD MODEL

20,000 r.p.m. Weighs 16 oz. $10.75 Postpaid with 3 Accessories.

200 ACCESSORIES

Quality built. Largest assortment, one for every job. See at dealers or in catalog.

GET A DEMONSTRATION

at any store or order either model on 10-Days Money-Back Trial. Catalog Free.

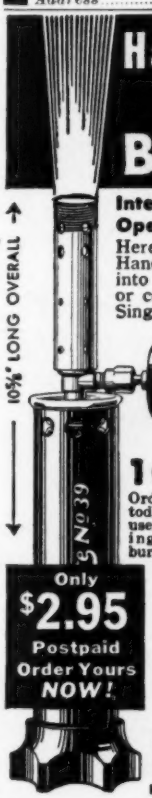
Chicago Wheel & Mfg. Co., 1101 W. Monroe St., Dept. P.S., Chicago, Ill.

☐ Send Catalog ☐ De Luxe Model P.S. 1
☐ Ultra De Luxe Set ☐ Standard Model ☐ Send C.O.D.

Name.....

Address.....

Handy . . . Automatic
JUSTRITE
BLO-TORCH



Intense Flame . . . Easy to Handle
Operates at Less than 1c per Hour!

Here's a torch that's "tops" in every way! Handy — easy to carry — small enough to get into tight places. Automatic — no pumps or complicated pressure controls to adjust. Single regulating valve controls flame. An ideal tool for metal craftsmen, electricians, mechanics and plumbers. Does a real job at low cost!

NO PUMPS—ONLY ONE MOVING PART!

101 USES!

Order your Justrite Blo-Torch today—you'll find hundreds of uses for it. Excellent for working and tempering metal, burning off paint, bending glass, melting glue, thawing pipes, small blacksmithing operations, most all soldering work, and a host of other jobs around shop, farm or home. 100% satisfaction guaranteed—10-day money-back trial. See it at your dealer's or order direct. Shipped either postpaid or C.O.D.

Only **$2.95** Postpaid
Order Yours NOW!

FREE!
SOLDERING IRON POINT

if you order now! Converts Blo-Torch into self-heating soldering iron—can be used anywhere—not dependent upon any other source of heat. Act today!

JUSTRITE MANUFACTURING CO.
2052 Southport Avenue, Chicago, Illinois

Everything in RADIO at LOWEST PRICES!

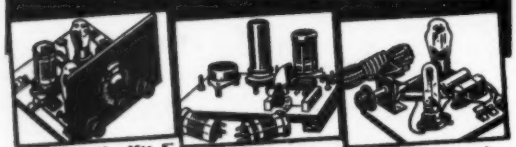
Sets • Parts • Kits
P.A. • Ham Gear • Testers
FREE! 180 Page Catalog

1939 KNIGHT SETS at New Low Prices!

See the amazing new 1939 Knight Radios in your ALLIED Catalog! New features—Push-Button Tuning, "Low-Boy" cabinets, 1½ volt tubes, etc.—at new low prices. 62 models, some as low as $6.95, 4 to 16 tubes, in AC, AC-DC, 1½ Volt, 6 Volt and 32 Volt models. Also new "Tiny Knights", phonographs, phono-radio combinations, record players, etc. They're all in ALLIED's 1939 Catalog—the Buying Guide of Radio Buyers!

Choose from 62 MODELS

KITS! Complete-Ready to Build! Send for FREE Parts Lists!



2 Tube DX'er Kit! The favorite receiver of thousands! Low in cost, efficient, easy to build. Less coils.....$3.98

20 Watt X'mitter Advanced type 6L6 Beam-Power Transmitter for C.W. Tunes all bands. Complete, less tube, crystal, and key.....$3.60

Photo Cell Kit! Ideal for burglar alarms, controlling lights, starting and stopping motors, etc. Complete.....$5.85

BEGINNERS! SEND FOR Allied's RADIO BUILDER'S HANDBOOK

A new and different type of book, planned especially for radio beginners. Tells how to select circuits, read diagrams, make chassis, solder, wind coils, etc. Packed with valuable data. Send coupon with 10c for your copy today! Only 10c.

FREE PARTS LISTS. We can supply Free Parts Lists covering hundreds of kits, including those above. Write!

SAVE MONEY ON ALL YOUR RADIO NEEDS

The new ALLIED Catalog also shows 14,000 radio parts, new P. A. Systems from 8-65 watts, Amateur Gear, Test Equipment, books, tools, etc. Write for your Free copy today—you'll save and profit on every order!

ALLIED Radio Corp.,
Dept. 7-A-9
833 W. Jackson Blvd.,
Chicago, Ill.

☐ Send me your Free 1939 Catalog.
☐ Enclosed find 10c for Radio Builder's Book.
☐ Send me parts list for.....
Name.....
Address.....

He Builds Fire Engines

(Continued from page 110)

water into the 1,200-foot tunnel, and the loss reached $100,000 before the flames died down.

A few days later, a railroad engineer called the little shop, saying, "we need a truck for fighting tunnel fires."

"How much water must she carry?" was Smillie's only question.

"All she can."

Smillie drew rough sketches, planned a combination truck and trailer, and delivered the unit a few weeks later. Mounted on flanged wheels, truck and trailer stand on a siding near Jacumba, Calif., ready for a quick dash to any tunnel on the line. Eight hundred gallons of water fill the tanks. The steering wheel of the old automobile is disconnected, and Smillie installed a new transmission so the equipment can roll as fast backward as forward.

As a boy, Smillie tinkered with metal. When he left school a quarter century ago, he decided some day he would conduct his own business. Soon he had a shop in downtown San Diego, where he soldered gasoline tanks and built sirens for state motor-cycle patrolmen. It was then he developed a trick which enables him to apply heat to gas tanks immediately after removing the fuel. "Run the torch across the bottom briefly," is his method, "which warms the vapor and expands it. Stick the flame down into the neck, and . . . poof . . . out she comes. No explosions, no runs, no injuries."

Before automobiles came along in large numbers, he built two-horse milk wagons. Some of these ran up to $2,500, and were quite elaborate. On hearing of his skill with these jobs, an automobile dealer, stuck with nine small obsolete cars, asked Smillie to build new bodies on them. That was before the day of streamlining, yet his creations were on the modernistic order. Retopped and repainted, the lot sold at $450 apiece. Three weeks earlier, a purchaser could have had all of them together for the same price.

Between trucks, when not working on some complicated job of metal construction, tiny charger boxes for hearing-aid batteries, or copper-petal flowers, Smillie putters around his shop, making all-metal model ships and play houses.

For rural districts, where traffic officers are virtually unknown, he designed a sheet-metal cop. He stood in front of a panel one day while his wife outlined his figure with chalk. Later he cut out the figure, painted the features and uniform. Now the metal cop stands beside the road to warn motorists.

"IT TAUGHT THE OLD DOG A NEW TRICK"

"Typing's a cinch—with a Royal. I work out ideas on it. I get a raise Jan. 1. Happy New Year!"

"Junior showed us your ad as a Christmas hint," writes W. W. B. "Wanted a Royal Portable for his homework."

"But with your Free Home Trial offer I said 'Why wait?'. So we sent in the coupon that very night."

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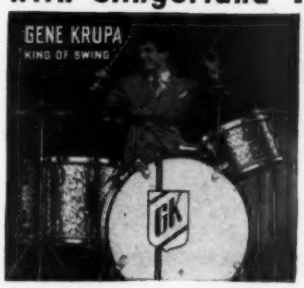

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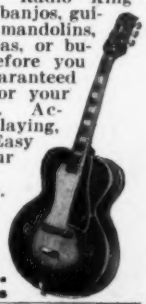

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Gas Chemistry for the Home Experimenter

(Continued from page 195)

decompose the cupric chloride, forming chlorine gas, water, and another copper compound called cuprous chloride. The water condenses on the upper walls of the test tube, while the chlorine issues from the side outlet, and may be led through rubber tubing where needed.

With this miniature chlorine generator, you can strikingly demonstrate the bleaching power of chlorine gas. An ordinary photographic print, either wet or dry, will become entirely bleached if you hold it in a stream of chlorine gas issuing from the test tube. The tiny black particles of silver that form the image are converted to white silver chloride.

An entertaining bit of chemical magic—changing one picture into another—may be performed with the same apparatus. Draw a picture or cartoon, using a water solution of one of the many household dyes that can be bleached by chlorine gas for your ink. On the same sheet of paper, draw another cartoon with colorless or "invisible" ink, made by heating a weak potassium iodide solution to which a bit of starch has been added.

Now place the sheet of paper in a jar and expose it to a stream of chlorine gas. Soon the drawing made with the household dye fades from sight. In its place appears the second drawing, clearly outlined in black lines wherever you have traced with the "invisible" ink. The chlorine gas liberates iodine from the potassium iodide, and the iodine reacts with the starch to produce a dark coloration.

Under suitable conditions, chlorine gas torn from cupric chloride will recombine with copper. You can juggle the process back and forth, ending with a shiny coating of copper.

Roll some copper screen or several copper wires into a bundle, and insert this in a piece of glass tubing about a quarter of an inch in diameter and four to six inches long. Connect the tubing to the outlet of your side-necked test tube, or to an ordinary test tube fitted with a one-hole stopper and a piece of tubing for a gas outlet. Place a little cupric chloride in the tube and heat it as before, while another burner plays upon the tubing holding the copper.

First the chlorine gas will recombine with the copper in the heated tubing, and then the compound will be decomposed by the flame playing along the tubing. Now, if you hold the burner at the end of the tubing, a beautiful bluish-green flame will appear, formed by the recombination of copper and chlorine. Hold the cold bowl of a clay bubble pipe in this flame, and a coating of metallic copper will form upon it.

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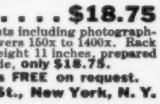

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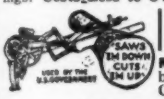

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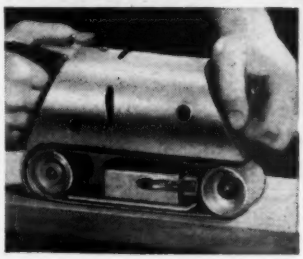

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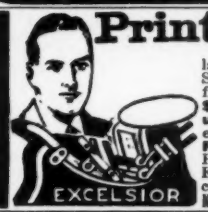

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WOLLENSAK

Your Microscope Reveals Marvels in Common Foods

(Continued from page 201)

of xylol, carbon tetrachloride, dry-cleaning fluid, or other grease solvent, for a minute or two. Then proceed with the other steps as outlined. (For further information on bacteria see P.S.M., Dec. '37, p. 100.)

Don't be alarmed if you find numerous bacteria in the family milk supply. Even milk that comes from a first-class pasteurizing plant contains them, including the disease-producing varieties; but they are dead and therefore harmless. Pasteurizing kills bacteria but does not remove them.

If the cook happens to be cleaning a chicken or other fowl while you are exploring the kitchen, you can obtain some interesting blood specimens. Simply place a little blood on a clean slide—or, preferably, three or four such slides—and spread it out into a thin film with the edge of a square cover glass or another slide. Let it dry and fix it by immersion in absolute alcohol for a few minutes; or simply wave the slide through the air until it is dry. Stain if desired, preferably with Giemsa or other standard blood-staining solution.

The bones of beef, chickens, and other animals used as food offer possibilities. Longitudinal and cross sections can be made by methods described previously in this series (P.S.M., March '38, p. 96), and their structures studied.

Kitchen specimens for your microscope are almost numberless. With your magic lens, you can study the bacteria in dish water, the algæ and other bits of matter you can filter out of tap water, the muscle fibers and other things in the tissues of beef, fowl, and other food animals; some of the strange characteristics of feathers, the secrets of pastry flour and starch—and, speaking of starch, scrape the surface of an Irish potato with a knife, spread some of the milky fluid on a slide, and look at it. The little oval things you see are starch grains; and if you have polarized-light equipment, you will find that each of them shows the characteristic dark cross, by which microanalysts identify starch in unknown food samples.

Bubbles in Slow Motion

SLOW-MOTION movies of air bubbles rising through water, exhibited recently before a meeting of scientists, revealed that the bubbles are not spherical as is commonly believed. Drops of water bouncing around inside create waves on the surface walls of each bubble.

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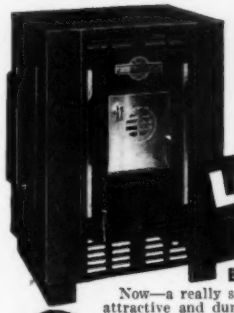

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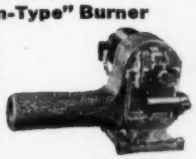

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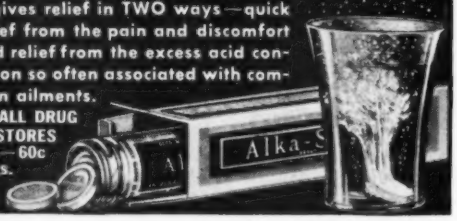

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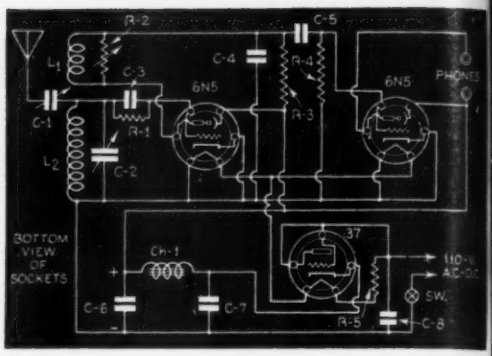


This Radio "Winks"

(Continued from page 207)

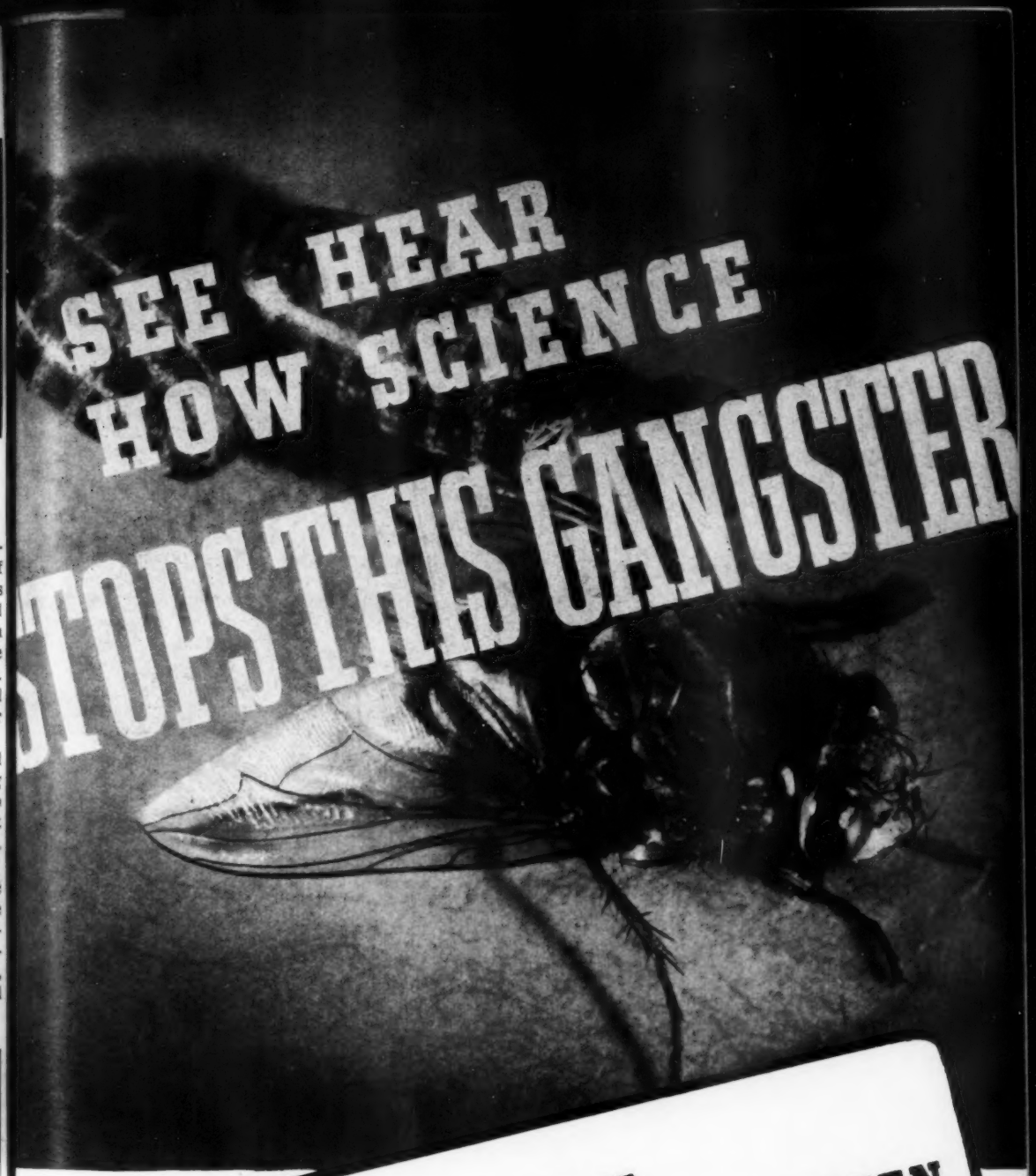
hook-up of this type. The tube has a .15-ampere, low-drain heater, so the heaters of the two 6N5's are connected in parallel, thus equaling one .30-ampere tube. The parallel arrangement permits wiring the tubes in series with the third tube, a .30-ampere type 37, using a standard-size line-cord resistor. The type 37 plays no part in the signal portion of the circuit, but acts as a power rectifier to provide the "B" voltage.

The tuning-eye tubes must be mounted horizontally. This is accomplished by using a second panel parallel to the front one to support the standard six-prong sockets (not the special ones designed for these tubes). Both panels are of a composition wood.

The dual filter condenser is mounted on the back of the rear panel. The filter choke (Ch_1) is on the inside of the rear panel. Below, on the baseboard, are the tuning condenser, coil, antenna trimmer condenser, plate condenser, line-filter condenser, and the socket for the type 37 tube.

LIST OF PARTS

C1—Trimmer condenser, 3-35 mmf.
C2—Variable condenser, .000365 mfd.
C3—Fixed condenser, mica, .00025 mfd.
C4—Fixed condenser, mica, .0005 mfd.
C5—Fixed condenser, paper, .05 mfd.
C6, C7—Dual filter condenser, 10 mfd., 200 volt.
C8—Fixed condenser, paper, .02 mfd.
R1—Resistor, 2 meg.
R2—Variable resistor, 0-25,000 ohm, with switch (Sw).
R3, R4—Fixed resistors, 250,000 ohm, ½ watt.
R5—Resistor (in line cord), 360 ohm.
L1, L2—Midget solenoid radio-frequency coil. (Remove two thirds of primary windings.)
Ch1—Filter choke, 15 henry.
Miscellaneous:—Tube sockets, wire, panels, phone jack, etc.



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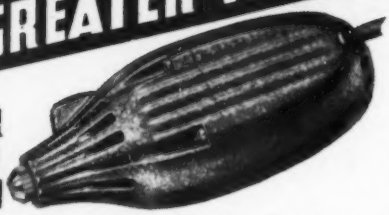

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Gas-Line Grief

(Continued from page 142)

right, think of pretty nearly everything else on earth before they think of the gas line. Once I saw a fellow take his engine pretty well apart—and get everything out of adjustment—trying to find out why he couldn't get a kick out of it. And what was the trouble? The vent hole in his gas tank had got stopped up! When that happened, of course no air could get into the tank to replace the gasoline that was used, the gasoline flowing out created a vacuum in the tank, and the vacuum finally stopped the flow of gas to the carburetor. He could have located and cured the trouble in ten minutes—if he had gone about it in the right way."

"What's the right way?" Joe asked.

"A gasoline engine can't run if it doesn't get gas," Gus said. "So whenever an engine won't start, or stops after it has started—especially if the explosions get weaker and weaker until it stops—it's only common sense to make certain that the engine is getting gas before you go looking for some other cause of it stopping.

"When an engine won't start, and the battery is strong and the starting motor spins, the gas line should be checked right away!

"First of all, the tank should be examined to make certain that there is gasoline in it. Gauges sometimes get out of order, and don't tell the truth. If there is gasoline in the tank, find out whether it is flowing to the carburetor. You can do that by disconnecting the gas pipe from the pump to the carburetor. If that's clean, get some one to watch for you while you step on the starter. If gasoline is reaching the carburetor, it will flow from the pump when you do that. If it isn't, the trouble almost certainly is a clogged fuel line, or vacuum tank, if your car has one, or a busted gas pump.

"Check the fuel line first. See that the vent hole in the gas tank isn't clogged. If it is open, take a careful look at the filter screen—if there is one—at the bottom of the tank. It may have become clogged with dirt or sediment. Then check the standpipe through which gasoline is drawn to the vacuum tank. It may be either clogged or cracked.

"If the gasoline tank is all right, take off the gasoline pipe and clean it—either by blowing it out, or by running a wire through it. Check the unions between the gasoline and vacuum tanks. They leak sometimes, too.

"If the gasoline pipe isn't clogged, and its

(Continued on page 240)

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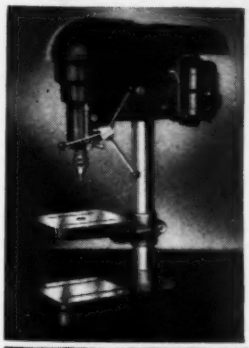

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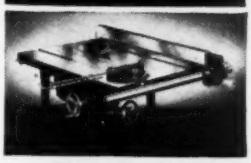

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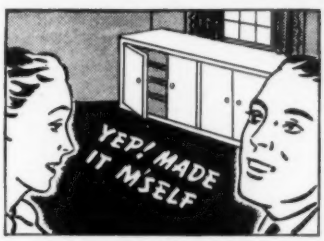

● Often the finished job that looks best comes from knowing which saw to use, rather than better handling of the tools. A single hand saw is not an all-purpose tool. A rip saw does its particular job better than a cross cut would, and vice versa, while several others are each best for certain work. The *right* saw is an Atkins, and which type to use is explained in a helpful booklet. Send 10c for the "How To Do It Book."

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Give Books for Christmas! Be sure to see the Special Announcement on pages 246 and 247.

Gas-Line Grief

(Continued from page 238)

unions are tight, the trouble most likely is in the vacuum tank.

"Open the drain cock at the bottom of the tank, and run a wire through it. If no gasoline comes out, there is none in the lower chamber. Check the strainer at the top of the tank. If it isn't clogged, examine the flapper valve in the lower chamber. Sediment may be holding it open.

"As for the gas pump, you've taken plenty of those apart," said Gus, who hadn't even slowed down a pace as he talked and worked at his bench. "One thing to remember always is not to bother to repair anything on it. Take it apart and give it the once over. New parts are cheap, and you can save money for all concerned by simply replacing the parts that are broken or worn out with new ones."

Radio-Static Suppresser Is Designed for Planes

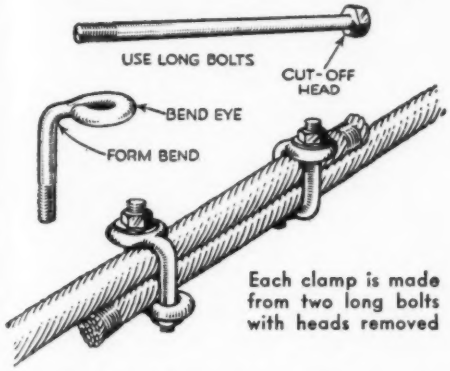
MEASURING only two by six inches, a new-type static suppresser has been designed for use in airplanes when static impedes good radio reception. The device consists of a cylinder fixed to one end of the horizontal stabilizer. It contains a five-foot coiled wire, grounded to the plane at one end. If conditions warrant, the wire coil is released electrically by the pilot, becoming in effect a trailing antenna with a sharp point at the end through which static electricity is automatically discharged into the air, instead of into the sensitive radio apparatus.

POPULAR SCIENCE Question Bee

How did you fare in the Question Bee on page 136? Compare your results with the list below, in which the letter alongside each number indicates the correct answer to the corresponding question. Allow yourself five points for each question that you answered correctly. A total score of 75 to 85 is good; 90 or better is excellent.

1. b	5. b	9. c	13. c	17. c
2. b	6. c	10. b	14. b	18. c
3. c	7. b	11. b	15. c	19. b
4. a	8. a	12. a	16. b	20. a

Clamps for Wire Cables Improvised from Bolts



CLAMPS for joining wire cables may be improvised when necessary from ordinary bolts. The heads are cut off bolts of suitable length, an eye formed in the unthreaded end of each, and a bend made as shown. The bolts are then used in pairs to act as clamps.

Paper Covering Keeps Workbench Clean

IN A CORNER of my shop, I have an L-shaped workbench, about 6′ long one way, 8′ the other. The top of the 6′ bench, which is made up as a drawer cabinet, is covered with ¼″ plywood, sanded smooth and painted. This is used for designing, assembling, fitting, and testing projects.

To keep the top clean and also provide a place for me to make sketches, detail drawings, and the like, I mounted under the top at the back a roll of wide, tough wrapping paper. The end of the paper is drawn through a ¼″ space between the bench top and the wall, then carried over the bench top itself to the front edge. Here the paper runs through another narrow slot. When the paper becomes soiled or I am through using the sketches on it, it is a simple matter to pull the end until a fresh surface is exposed. What work I do at the bench is often done right on top of a full-size layout sketch I have made for the purpose.

The larger bench is covered with common building paper. Two or three thicknesses are tacked on with thumb tacks, driven in with a hammer. When the top is soiled with oil from motor bearings and the like, I merely rip off the paper and put on a new covering. This takes about fifteen minutes and is required about once a month under ordinary conditions. It keeps the workbench looking neat at all times and the cost is practically nothing.—M. L. FULLER.

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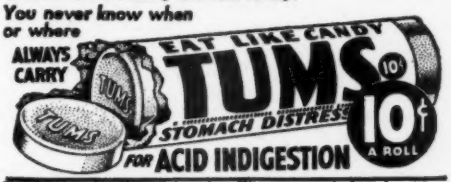

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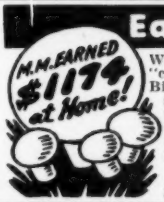

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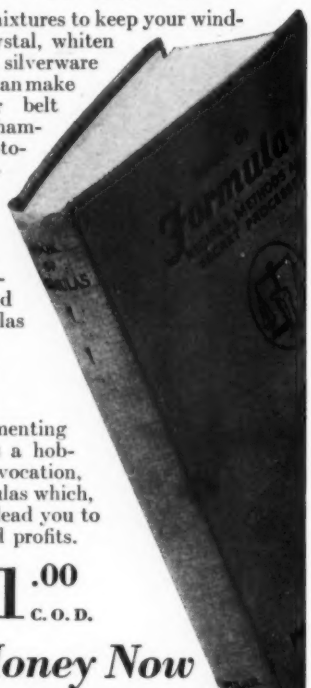

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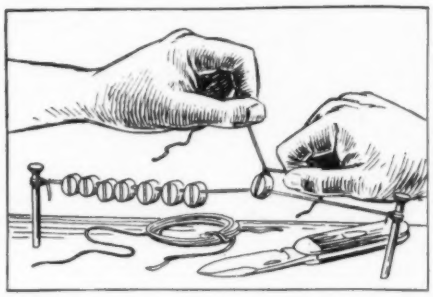
An Easy Way to Apply Straps to Ship-Model Blocks



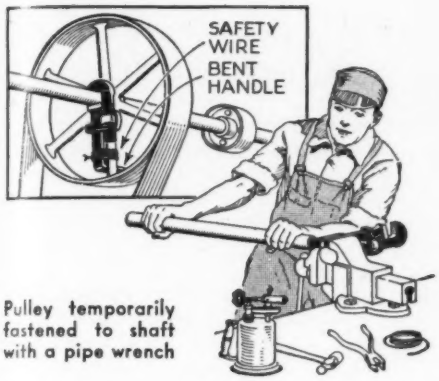
BLOCKS for ship models can be "strapped" with thread or wire more conveniently and quickly, and are also less likely to be lost, if they are strung on a wire stretched between two nails as shown above. This method is equally useful when the blocks have to be painted.—WARREN F. ROBINSON.

Old Plywood Packing Cases Serve Many Purposes

LARGE plywood boxes such as are commonly used for shipping electric refrigerators can often be had at a trifling cost from refrigerator dealers. They therefore offer an inexpensive source of plywood panels for many uses around the home. One of these is as wall board where looks are not important. As each panel has its individual framework, it is quite rigid, and only a light studding is necessary upon which to build a dividing partition such as might be desirable in the cellar to hide the heater or to close in a playroom. They will also serve to cover over the rafters in an attic to make it warmer and easier to keep clean. The plywood makes sturdy drawer bottoms and tops for card tables, and backs for chests of drawers, dressers, and other pieces of furniture you are repairing.—ARTHUR L. D. FORD.

Bone-Glue Mixture Protects Against Welding Spatters

THE bothersome spatter of hot metal and oxides from arc welding can be easily removed if the surfaces around the weld have been painted lightly with a mixture of half linseed oil and half bone glue of high viscosity. The coating, which prevents the small globules of hot metal from burning and sticking, may be wiped or washed off with hot water. This application will not damage most finishes, and is invaluable when welding on or near machined surfaces.—LESTER J. KING.



Pulley temporarily fastened to shaft with a pipe wrench

Wrench Holds Slipping Line-Shaft Pulley

WHEN a 20″ steel pulley on a heavily loaded line shaft began to slip and it was impossible to shut down the plant more than a few minutes at a time to make repairs, we bent the handle of a 16″ pipe wrench at right angles about 7″ from the end and applied the wrench to the shaft as shown. A wire was wrapped around the handle as a safeguard. The wrench held firmly until it was possible to make permanent repairs several months later.—N. S. MCEWEN.

Spreading Asphalt on Pipes to be Laid Underground

CHEAP road asphalt will protect black pipe from corrosion in underground work and thus effect a large saving in cost over galvanized pipe, which is considerably higher. Painting the asphalt on with a brush is, however, slow work, and at the end of the job the brush is usually of no further value. Here is a much quicker and better method:

Place under the pipe a piece of discarded inner tube rubber approximately 10″ by 15″. Raise the rubber up around the pipe and hold it at each end tightly at the top, allowing the middle to sag. Have a helper pour the warm liquid asphalt into the sagged portion of the rubber; then draw the rubber along the pipe. This leaves a deposit of asphalt as thick as will remain on the surface.

An extra heavy deposit is automatically left at each end of the couplings as the rubber stretches over them, and this protects the exposed threads from corrosion. The threaded portion is the thinnest part of the pipe, and this part, it should be noted, is not protected at all by galvanizing in laying galvanized pipe. I have seen asphalt-covered pipe removed after twenty years that was in much better condition than galvanized.—S. R.

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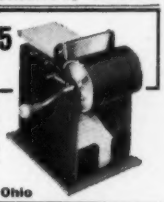

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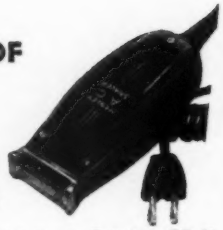

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Working from Plans Drawn on a Different Scale

IN MODEL making, especially in connection with model railways, it is often necessary to use plans drawn on a different scale from the one desired. There are, of course, various ways to overcome this difficulty. If proportional dividers are available, they may be used, or a cardboard scale or graph may be prepared with drafting instruments. When arithmetic alone is to be relied on, all that is necessary is to find the conversion factor. This is simply the figure by which the dimensions on the drawing have to be multiplied to convert them to the required scale.

The conversion factor is the required scale divided by the given scale. Suppose, for example, you are building a ship model from plans that are drawn on a scale of ⅛" equals 1', but the scale you wish is 5/16" equals 1'. Divide 5/16 by ⅛ and you get a conversion factor of 2½. This means that all dimensions as given on the plan are to be multiplied by 2½ in order to build to the 5/16" scale.

To convert from a scale in millimeters to one in inches is almost as easy. Suppose you are building an HO-gauge car on a scale of 3.5 mm. equals 1', but the plans give dimensions on the scale of ¼" equals 1'. First change 3.5 mm. to inches by multiplying by 0.03937, since 1 mm. equals 0.03937". This gives you 0.138". Now divide 0.138 by ¼ (0.25) and you find the conversion factor is 0.552. If all dimensions given for the ¼" scale are multiplied by this, you will have the correct dimensions for the 3.5-mm. scale in terms of decimals of an inch.—C.V.

How to Cut Thin Washers with a Hack Saw

WHEN very thin washers are required and a lathe is not available, they can be cut by placing two blades in a hack-saw frame, separated with a spacer of the proper thickness. The spacer can be held in place with a piece of friction tape or a small clamp.

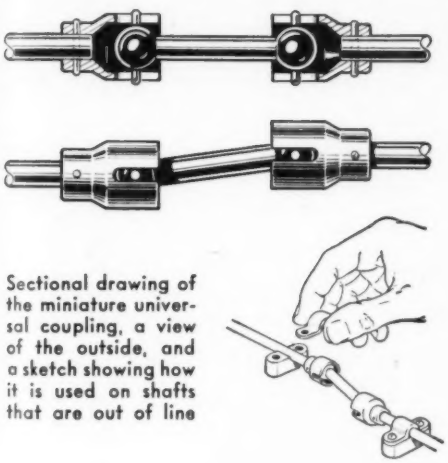
Small, Delicate Models Sanded with Finger-Nail Strips

NARROW, flexible abrasive strips or emery boards, which are sold at trifling cost by the package for manicure use, are very effective for sanding small, delicate models and many types of irregularly shaped parts. Model makers should always keep a supply on hand.—RICHARD PATRICK.

Universal Coupling for Small Models

MODEL makers or experimental mechanics sometimes require a really small universal coupling. The one illustrated was designed for use in a model locomotive, where the requirements were ease of construction, dependability, and quiet operation at either high or low speeds. The unit has a maximum diameter of only 5/16", and connects two ⅛" shafts, which are about 1¼" apart. Despite its small size, the coupling has given excellent service over long periods.

The coupling consists of two slotted sockets, one on each shaft, and a short intermediate shaft with a ball and pin at each end. It is best to make the sockets first. Mount a short length of steel rod in the lathe and, using a drill in the tailstock chuck, drill to the shaft diameter. Open out the drilled hole to about twice its diameter for the depth shown, and then cut off. When two of these are finished, carefully saw or file the slot to fit the pins.



Sectional drawing of the miniature universal coupling, a view of the outside, and a sketch showing how it is used on shafts that are out of line

Turn the entire length of the intermediate shaft until it is a close fit in the sockets; then reduce the center portion to about one half the diameter, and finish the ball ends with a hand turning tool or a fine file. Complete the shaft by drilling the ends and forcing in the pins.

The coupling may be made from any available material, but steel sockets and an intermediate shaft of bronze will give the strongest and slowest wearing combination. Brass may, however, be used with satisfactory results. In any case the pins should be of steel.

A bit of cotton pushed into each socket before the shaft is inserted will help retain the lubricant.—L. F. BEACH.

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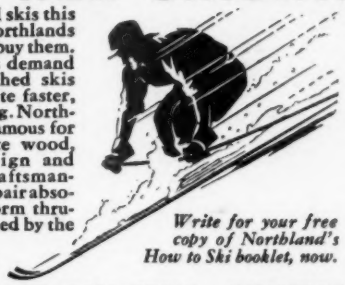

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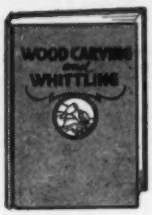

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